

Peralta Community College District

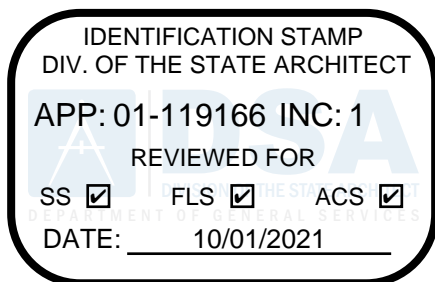
**Merritt College
Child Development Center**

**12500 Campus Drive
Oakland, California 94619**

Increment 1

PROJECT MANUAL

**DSA Back Check
DSA Application No. 01-119166
September 7, 2021**



**Architect
AE3 PARTNERS
275 Battery Street, Suite 1050
San Francisco, CA 94104**

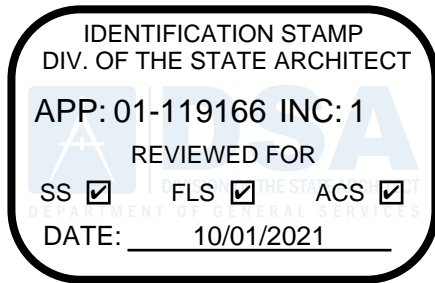
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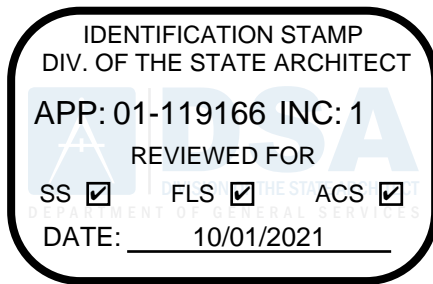
DESIGN PROFESSIONALS OF RECORD

Discipline: Architectural
Consultant: AE3 Partners
Name: Doug Davis
License No.: C28047

Responsible for Divisions 02-33 Sections except where indicated as prepared by other design professionals of record.



Discipline: Civil Engineer
Consultant: KPFF
Name: Ryan Beaton
License No.: 82786
Responsible for Sections 31 1000, 31 2000, 32
1216, 33 1116, 33 3100, 33 4100



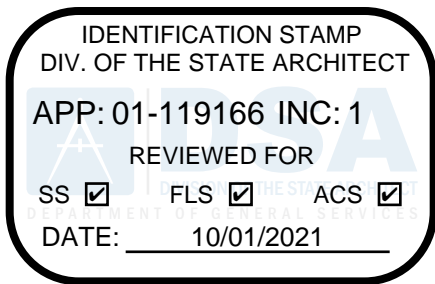
Discipline: Landscape Architect:

Consultant: Keller Mitchel & Co.

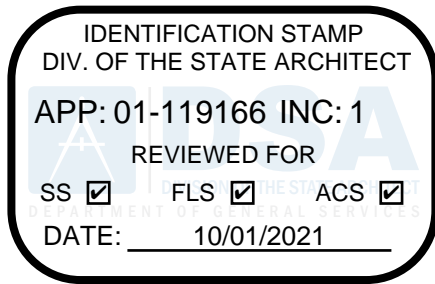
Name: Amy Cupples

License No.: CA 4488

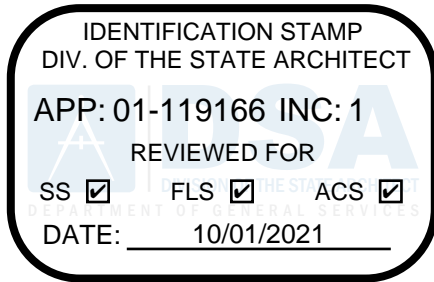
Responsible for Sections 01 5639, 02 4216, 06 2013, 11 6813, 31 1413, 32 1313, 32 1500, 32 1816, 32 1817, 32 3119, 32 3300, 32 8400, 32 9110, 32 9113, 32 9219, 32 9223, 32 9300, 33 4300



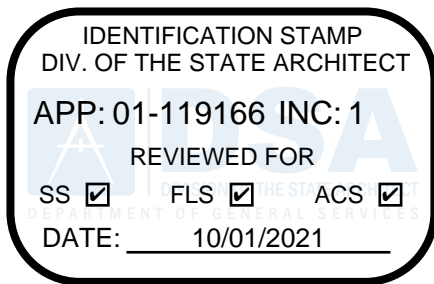
Discipline: Structural Engineer
Consultant: KPW Structural Engineers, Inc
Name: John Westphal
License No.: 4S575
Responsible for Sections 03 1000, 03 2000, 03 3000, 05 1200, 05 3100, 05 4000



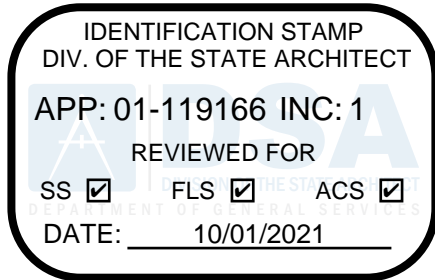
Discipline: Plumbing Engineer
Consultant: Integral Group
Name: Ehsan Daryaram
License No.: M-38661
Responsible for Division 22



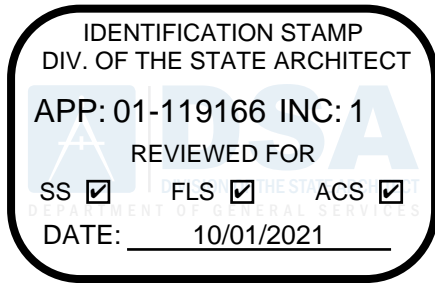
Discipline: Mechanical Engineer
Consultant: Integral Group
Name: Ehsan Daryaram
License No.: M-38661
Responsible for Division 23



Discipline: Electrical Engineer
Consultant: Integral Group
Name: Cirilo P. Marquez
License No.: E-14506
Responsible for Division 26



Discipline: Communications Engineers
Consultant: Integral Group
Name: Cirilo P. Marquez
License No.: E-14506
Responsible for Division 27
Responsible for Sections



Discipline: Electronic Safety and Security
Engineer:

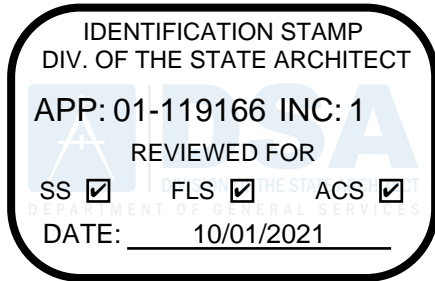
Consultant: Integral Group

Name: Cirilo P. Marquez

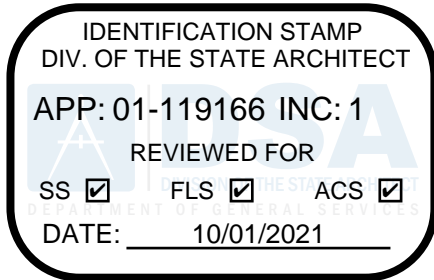
License No.: E-14506

Responsible for Division 28

Responsible for Sections



Discipline: Fire-Protection Engineer
Consultant: Interface Engineering
Name: Kenton Aikens
License No.: 1689
Responsible for Division 21



Discipline: Roofing

Consultant:

K2M Design

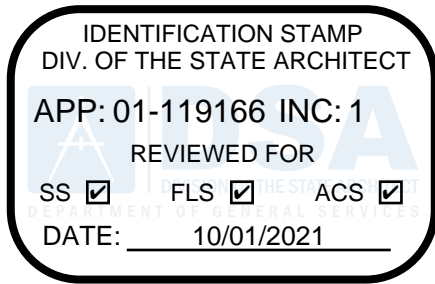
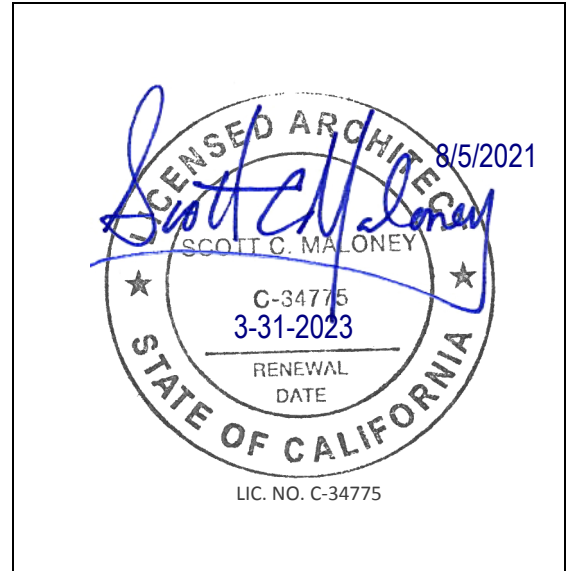
Name:

Scott Maloney

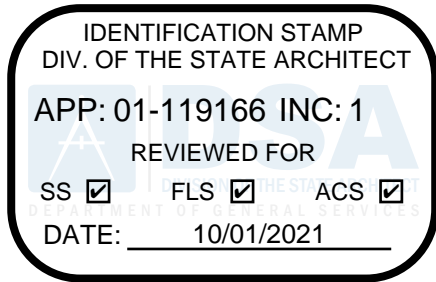
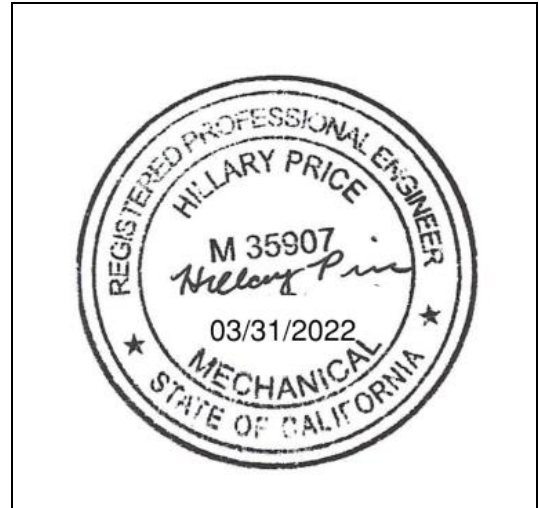
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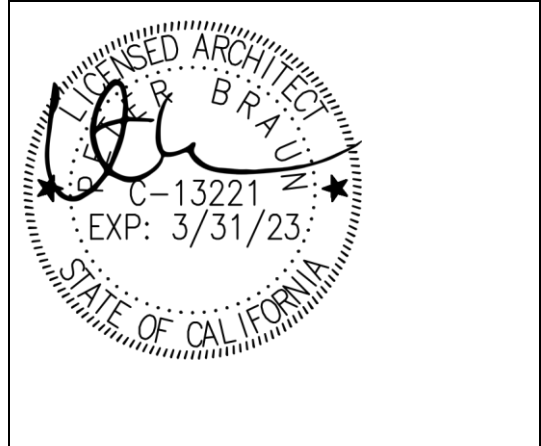
Responsible for Sections: 07 1413, 07 2620,
07 5420



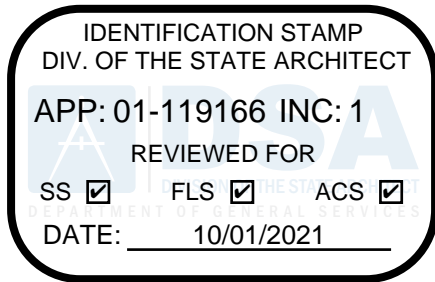
Discipline: Commissioning
Consultant: Red Car Analytics
Name: Hillary Price
License No.: M35907
Responsible for Sections: 019100



Discipline: Food Service
Consultant: Restaurant Design Concepts
Name: Peter Braun
License No.: C-13221
Responsible for Sections 11400



END OF DOCUMENT



PROJECT MANUAL INCLUDING SPECIFICATIONS
 FOR
Merritt College
Child Development Center
Increment – 1

12500 Campus Drive
Oakland, California

AE3 Partners Project No. 2019025

DOCUMENT 000110
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None.

END OF DOCUMENT

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LIST OF SCHEDULES

SCHEDULES

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S/A-1002	WINDOW TYPES AND LOUVER TYPES
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S/A-1004	FIRST FLOOR SIGNAGE SCHEDULE
S/A-1005	SECOND FLOOR SIGNAGE SCHEDULE
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END OF DOCUMENT

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LIST OF SCHEDULES

SCHEDULES

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L/A-1002	WINDOW TYPES AND LOUVER TYPES
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L/A-1004	FIRST FLOOR SIGNAGE SCHEDULE
L/A-1005	SECOND FLOOR SIGNAGE SCHEDULE
L/S-401	STUD SCHEDULE, HEADER SCHEDULE, JAMB SCHEDULE
L/S-510	SPREAD FOOTING SCHEDULE, GRADE BEAM SCHEDULE
L/S-700	SHEAR TAB SCHEDULE, COLUMN BASE PLATE SCHEDULE
L/S-710	METAL DECK SCHEDULE
L/S-720	SCBF CONNECTION SCHEDULE
L/S-900	METAL STUD NOTES & SCHEDULE
L/S-910	METAL STUD NOTES & SCHEDULE
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L/M-601	DIFFUSER SCHEDULE
L/M-601	LINEAR DIFFUSER SCHEDULE
L/M-601	GRILLE SCHEDULE
L/M-601	ROOM NC LEVEL
L/P-601	DRAIN, CLEANOUT AND PLUMBING SPECIALITY
L/P-601	FIXTURE SCHEDULE
L/P-601	PIPE MATERIAL SCHEDULE
L/E-003	LIGHTING FIXTURE SCHEDULE
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END OF DOCUMENT

DOCUMENT 00 11 16

NOTICE TO BIDDERS

1. Notice is hereby given that the governing board ("Board") of the Peralta Community College District ("District") will receive, by electronic submission, bids for the following project, Bid No. _____, Bid Package _____ ("Project" or "Contract"):

2. The Project consists of:

Construction of a new two-story classroom building with preschool and adult classrooms, administrative offices, food service facility, teacher preparation rooms, resource room and restrooms. The work includes associated civil, landscape, architectural, structural, plumbing, mechanical, electrical, fire alarm, fire protection, low voltage and food service work as indicated in the Drawings and Specifications. The project involves all new work and finishes. The Project involves two increments – Increment 1 includes all site work, including site clearing, grading, utilities, and landscape, classrooms, offices, elevator, stairs, food service, restrooms and major MEP systems; Increment 2 includes the addition of preschool and adult classrooms and the continuation of MEP systems.

3. To bid on this Project, the Bidder is required to possess one or more of the following State of California contractor license(s):

B – General Contracting

The Bidder's license(s) must remain active and in good standing throughout the term of the Contract.

4. To bid on this Project, the Bidder is required to be registered as a public works contractor with the Department of Industrial Relations pursuant to the Labor Code.

5. Contract Documents will be available on or after _____, 20____, for review at the District Vendor Registry website, and may be downloaded from the District's website, <https://vrapp.vendorregistry.com/Bids/View/BidsList?BuyerId=4d041f6c-7568-4c8a-8878-c82684292a3c>, using the **["Facilities Project and Information"]** link. In addition, Contract Documents are available for bidders' review at the following builders' exchanges:

- A. Builder's Exchange of _____ County (____) _____ - _____
- B. A list of these builders' exchanges is available at the District's Facilities Office.

6. ***The District will only receive bids submitted electronically.*** Bids will be received until ___a.m./p.m., ____, 20____, only at the following email address [INSERT], after which time the bids will be opened and publicly read aloud via video conference. A link to the video conference will be provided by Addendum. Any bid that is submitted after this time shall be nonresponsive and returned to the bidder. **Each bidder is solely responsible for timely submission of its bid; the District is not responsible for any technological issues in a bidder's ability to timely**

submit its bid or portion thereof. Any claim by a bidder of error in its bid must be made in compliance with section 5100 et seq. of the Public Contract Code. Prior to publicly reading aloud bids at the video conference, the District reserves the right to verify the genuineness of any bid security.

7. Pursuant to Public Contract Code section 20111.5, only prequalified bidders will be eligible to submit a bid for this Project. Any bid submitted by a bidder who is not prequalified shall be non-responsive and returned by email to the bidder.
8. All bids shall be on the form provided by the District. Each bid must conform and be responsive to all pertinent Contract Documents, including, but not limited to, the Instructions to Bidders.
9. A bid bond by an admitted surety insurer on the form provided by the District, or a cashier's check or a certified check, drawn to the order of the Peralta Community College District, in the amount of ten percent (10%) of the total bid price, shall accompany the Bid Form and Proposal, as a guarantee that the Bidder will, within seven (7) calendar days after the date of the Notice of Award, enter into a contract with the District for the performance of the services as stipulated in the bid.
10. A mandatory pre-bid conference and site visit will be held on 20____, at ____m. at _____, California. All participants are required to sign in front of the _____ Building, _____, California. The site visit is expected to take approximately _____. Failure to attend or tardiness will render bid ineligible.
11. The successful Bidder shall be required to furnish a 100% Performance Bond and a 100% Payment Bond if it is awarded the contract for the Work.
12. The successful Bidder may substitute securities for any monies withheld by the District to ensure performance under the Contract, in accordance with the provisions of section 22300 of the Public Contract Code.
13. The Contractor and all Subcontractors under the Contractor shall pay all workers on all work performed pursuant to this Contract not less than the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work as determined by the Director of the Department of Industrial Relations, State of California, for the type of work performed and the locality in which the work is to be performed within the boundaries of the District, pursuant to section 1770 et seq. of the California Labor Code. Prevailing wage rates are also available from the District or on the Internet at: <<http://www.dir.ca.gov>>.
14. This Project is subject to labor compliance monitoring and enforcement by the Department of Industrial Relations pursuant to Labor Code section 1771.4 and subject to the requirements of Title 8 of the California Code of Regulations. The successful Bidder shall comply with all requirements of Division 2, Part 7, Chapter 1, Articles 1-5 of the Labor Code.
15. The District has entered into a Project Labor Agreement that is applicable to this Project. A copy of the Project Labor Agreement is available for review at the District Facilities Office and may be downloaded from the District's website, <https://build.peralta.edu/construction-project-labor-agreement>. The successful

bidder and all subcontractors will be required to agree to be bound by the Project Labor Agreement.

16. The District shall award the Contract, if it awards it at all, to the lowest responsive responsible bidder based on:
 - A. Base Bid for Increment #1 only.
 - B. The Base Bid for Increment #2 cannot exceed 25% of the Total Base Bid.
Total Base Bid = Base Bid for Increment #1 + Base Bid for Increment #2
17. The Board reserves the right to reject any and all bids and/or waive any irregularity in any bid received. If the District awards the Contract, the security of unsuccessful bidder(s) shall be returned within sixty (60) days from the time the award is made. Unless otherwise required by law, no bidder may withdraw its bid for ninety (90) days after the date of the bid opening.

END OF DOCUMENT

DOCUMENT 00 21 13

INSTRUCTIONS TO BIDDERS

Bidders shall follow the instructions in this document, and shall submit all documents, forms, and information required for consideration of a Bid.

Peralta Community College District ("District") will evaluate information submitted by the apparent low Bidder and, if incomplete or unsatisfactory to District, Bidder's bid may be rejected at the sole discretion of District.

1. Bids are requested for a general construction contract, or work described in general, for the following project ("Project" or "Contract"):

Merritt College New Child Development Center

2. Bidder and its subcontractors must possess the appropriate State of California contractors' license and must maintain the license throughout the duration of the project. Bidders must also be registered as a public works contractor with the Department of Industrial Relations pursuant to the Labor Code. Bids submitted by a contractor who is not properly licensed or registered shall be deemed nonresponsive and will not be considered.
3. The District has prequalified bidders pursuant to Public Contract Code section 20651.5. Only prequalified bidders will be eligible to submit a bid for this Project. Any bid submitted by a bidder who is not prequalified shall be deemed nonresponsive and will not be considered.
4. District will receive bids submitted electronically from bidders as stipulated in the Notice to Bidders.
 - a. Email subject line must include the name of the Bidder, name of the Project, the Project Number and/or bid number, and time of bid opening.
 - b. Bids must be electronically submitted to the following email address [INSERT], by date and time shown in the Notice to Bidders.
 - c. Each bidder is solely responsible for timely submission of its bid; the District is not responsible for any technological issues affecting a bidder's ability to timely submit its bid or portion thereof.
5. Bidders are advised that on the date that bids are opened, the District Offices will **not** be open to bidders or their representatives.
6. Bids will be opened and publicly read aloud via video conference. A link to the video conference will be provided by Addendum. Prior to publicly reading aloud bids at the video conference, the District reserves the right to verify the genuineness of any bid security.
7. Bidders must submit Bids on the documents titled Bid Form and Proposal, and must submit all other required District forms. Bids not submitted on the District's required

forms shall be deemed nonresponsive and shall not be considered. Additional sheets required to fully respond to requested information are permissible.

8. Bidders shall not modify the Bid Form and Proposal or qualify their bids. Bidders shall not submit to the District a re-formatted, re-typed, altered, modified, or otherwise recreated version of the Bid Form and Proposal or other District-provided document.
9. Bids shall be clearly written and without erasure or deletions. District reserves the right to reject any bid containing erasures, deletions, or illegible contents.
10. Bidders must supply all information required by each Bid Document. Bids must be full and complete. District reserves the right in its sole discretion to reject any Bid as non-responsive as a result of any error or omission in the Bid. Bidders must complete and submit all of the following documents with the Bid Form and Proposal:
 - a. Photocopy of Bid Bond on the District's form, or other security.
 - b. Designated Subcontractors List.
 - c. Site Visit Certification, if a site visit was required.
 - d. Non-Collusion Declaration.
 - e. Iran Contracting Act Certification, if contract value is \$1,000,000 or more.
 - f. SLBE/SELBE Self Certification Affidavit.
11. Bidders must submit with their bids a legible photocopy of (i) a cashier's check or (ii) a certified check payable to District, or (iii) a bid bond by an admitted surety insurer of not less than ten percent (10%) of amount of Base Bid, plus all additive alternates ("Bid Bond"). If Bidder chooses to provide a Bid Bond as security, Bidder must use the required form of corporate surety provided by District. The Surety on Bidder's Bid Bond must be an insurer admitted in the State of California and authorized to issue surety bonds in the State of California. Bidder must deposit the original of the bid bond, cashier's check, or certified check in the mail on the same day as the bid opening. Bids submitted without necessary bid security will be deemed non-responsive and will not be considered.
12. If Bidder to whom the Contract is awarded fails or neglects to enter into the Contract and submit required bonds, insurance certificates, and all other required documents, within **SEVEN (7)** calendar days after the date of the Notice of Award, District may deposit Bid Bond, cashier's check, or certified check for collection, and proceeds thereof may be retained by District as liquidated damages for failure of Bidder to enter into Contract, in the sole discretion of District. It is agreed that calculation of damages District may suffer as a result of Bidder's failure to enter into the Contract would be extremely difficult and impractical to determine and that the amount of the Bidder's required bid security shall be the agreed and conclusively presumed amount of damages.
13. Bidders must submit with the Bid the Designated Subcontractors List for those subcontractors who will perform any portion of Work, including labor, rendering of

service, or specially fabricating and installing a portion of the Work or improvement according to detailed drawings contained in the plans and specifications, in excess of one half of one percent (0.5%) of total Bid. Failure to submit this list when required by law shall result in bid being deemed nonresponsive and the bid will not be considered.

14. All of the listed subcontractors are required to be registered as a public works contractor with the Department of Industrial Relations pursuant to the Labor Code.
 - a. An inadvertent error in listing the California contractor license number on the Designated Subcontractors List shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive if the correct contractor's license number is submitted to the District within 24 hours after the bid opening and the corrected number corresponds with the submitted name and location for that subcontractor.
 - b. An inadvertent error listing an unregistered subcontractor shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive provided that any of the following apply:
 - (1) The subcontractor is registered prior to the bid opening.
 - (2) The subcontractor is registered and has paid the penalty registration fee within 24 hours after the bid opening.
 - (3) The subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.

15. If a mandatory pre-bid conference and site visit ("Site Visit") is required as referenced in the Notice to Bidders, then Bidders must submit the Site-Visit Certification with their Bid. District will transmit to all prospective Bidders of record such Addenda as District in its discretion considers necessary in response to questions arising at the Site Visit. Oral statements shall not be relied upon and will not be binding or legally effective. Addenda issued by the District as a result of the Site Visit, if any, shall constitute the sole and exclusive record and statement of the results of the Site Visit.

16. Bidders shall submit the Non-Collusion Declaration with their Bids. Bids submitted without the Non-Collusion Declaration shall be deemed non-responsive and will not be considered.

17. The Contractor and all Subcontractors under the Contractor shall pay all workers on all work performed pursuant to the Contract not less than the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work as determined by the Director of the Department of Industrial Relations, State of California, for the type of work performed and the locality in which the work is to be performed within the boundaries of the District, pursuant to sections 1770 et seq. of the California Labor Code. Copies of the general prevailing rates of per diem wages for each craft, classification, or type of worker needed to execute the Contract, as determined by Director of the Department of Industrial Relations, are available upon request at the District's principal office. Prevailing wage rates are also available on the internet at <http://www.dir.ca.gov>.

18. The District has entered into a Project Labor Agreement that is applicable to this Project. A copy of the Project Labor Agreement is available for review at the District Facilities Office and may be downloaded from the District's website, <https://build.peralta.edu/construction-project-labor-agreement>. The successful bidder and all subcontractors will be required to agree to be bound by the Project Labor Agreement.
19. Submission of Bid signifies careful examination of Contract Documents and complete understanding of the nature, extent, and location of Work to be performed. Bidders must complete the tasks listed below as a condition to bidding, and submission of a Bid shall constitute the Bidder's express representation to District that Bidder has fully completed the following:
 - a. Bidder has visited the Site, if required, and has examined thoroughly and understood the nature and extent of the Contract Documents, Work, Site, locality, actual conditions, as-built conditions, and all local conditions and federal, state and local laws, and regulations that in any manner may affect cost, progress, performance, or furnishing of Work or that relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto;
 - b. Bidder has conducted or obtained and has understood all examinations, investigations, explorations, tests, reports, and studies that pertain to the subsurface conditions, as-built conditions, underground facilities, and all other physical conditions at or contiguous to the Site or otherwise that may affect the cost, progress, performance, or furnishing of Work, as Bidder considers necessary for the performance or furnishing of Work at the Contract Sum, within the Contract Time, and in accordance with the other terms and conditions of Contract Documents, including specifically the provisions of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies, or similar information or data are or will be required by Bidder for such purposes;
 - c. Bidder has correlated its knowledge and the results of all such observations, examinations, investigations, explorations, tests, reports, and studies with the terms and conditions of the Contract Documents;
 - d. Bidder has given the District prompt written notice of all conflicts, errors, ambiguities, or discrepancies that it has discovered in or among the Contract Documents and the actual conditions, and the written resolution(s) thereof by the District, is/are acceptable to Bidder;
 - e. Bidder has made a complete disclosure in writing to the District of all facts bearing upon any possible interest, direct or indirect, that Bidder believes any representative of the District or other officer or employee of the District presently has or will have in this Contract or in the performance thereof or in any portion of the profits thereof;
 - f. Bidder must, prior to bidding, perform the work, investigations, research, and analysis required by this document and that Bidder represented in its Bid Form and Proposal and the Agreement that it performed prior to bidding.

Contractor under this Contract is charged with all information and knowledge that a reasonable bidder would ascertain from having performed this required work, investigation, research, and analysis. Bid prices must include entire cost of all work "incidental" to completion of the Work.

- g. Conditions Shown on the Contract Documents: Information as to underground conditions, as-built conditions, or other conditions or obstructions, indicated in the Contract Documents, e.g., on Drawings or in Specifications, has been obtained with reasonable care, and has been recorded in good faith. However, District only warrants, and Bidder may only rely, on the accuracy of limited types of information.
- (1) As to above-ground conditions or as-built conditions shown or indicated in the Contract Documents, there is no warranty, express or implied, or any representation express or implied, that such information is correctly shown or indicated. This information is verifiable by independent investigation and Bidder is required to make such verification as a condition to bidding. In submitting its Bid, Bidder shall rely on the results of its own independent investigation. In submitting its Bid, Bidder shall not rely on District-supplied information regarding above-ground conditions or as-built conditions.
 - (2) As to any subsurface condition shown or indicated in the Contract Documents, Bidder may rely only upon the general accuracy of actual reported depths, actual reported character of materials, actual reported soil types, actual reported water conditions, or actual obstructions shown or indicated. District is not responsible for the completeness of such information for bidding or construction; nor is District responsible in any way for any conclusions or opinions that the Bidder has drawn from such information; nor is the District responsible for subsurface conditions that are not specifically shown (for example, District is not responsible for soil conditions in areas contiguous to areas where a subsurface condition is shown).
- h. Conditions Shown in Reports and Drawings Supplied for Informational Purposes: Reference is made to the document entitled Geotechnical Data, and the document entitled Existing Conditions, for identification of:
- (1) Subsurface Conditions: Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that have been utilized by Architect in preparing the Contract Documents; and
 - (2) Physical Conditions: Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that has been utilized by Architect in preparing the Contract Documents.
 - (3) These reports and drawings are **not** Contract Documents and, except for any "technical" data regarding subsurface conditions specifically identified in Geotechnical Data and Existing Conditions, and underground facilities data, Bidder may not in any manner rely on the information in these reports and drawings. Subject to the foregoing,

Bidder must make its own independent investigation of all conditions affecting the Work and must not rely on information provided by District.

20. Bids shall be based on products and systems specified in Contract Documents or listed by name in Addenda. Whenever in the Specifications any materials, process, or article is indicated or specified by grade, patent, or proprietary name, or by name of manufacturer, that Specification shall be deemed to be followed by the words "or equal." Bidder may, unless otherwise stated, offer any material, process, or article that shall be substantially equal or better in every respect to that so indicated or specified. The District is not responsible and/or liable in any way for a Contractor's damages and/or claims related, in any way, to that Contractor's basing its bid on any requested substitution that the District has not approved in advance and in writing. Contractors and materials suppliers who submit requests for substitutions prior to the award of the Contract must do so in writing and in compliance with Public Contract Code section 3400. All requests must comply with the following:
- a. District must receive any notice of request for substitution of a specified item a minimum of **TEN (10)** calendar days prior to bid opening. The Successful Bidder will not be allowed to substitute specified items unless properly noticed.
 - b. Within 35 days after the date of the Notice of Award, the Successful Bidder shall submit data substantiating the request(s) for all substitution(s) containing sufficient information to assess acceptability of product or system and impact on Project, including, without limitation, the requirements specified in the Special Conditions and the Specifications. Insufficient information shall be grounds for rejection of substitution.
 - c. Approved substitutions, if any, shall be listed in Addenda. District reserves the right not to act upon submittals of substitutions until after bid opening.
 - d. Substitutions may be requested after Contract has been awarded only if indicated in and in accordance with requirements specified in the Special Conditions and the Specifications.
21. Bidders may examine any available "as-built" drawings of previous work by giving District reasonable advance notice. District will not be responsible for accuracy of "as-built" drawings. The document entitled Existing Conditions applies to all supplied "as-built" drawings.
22. All questions about the meaning or intent of the Contract Documents are to be directed via email to the District to _____. Interpretations or clarifications considered necessary by the District in response to such questions will be issued in writing by Addenda and delivered electronically to all parties recorded by the District as having received the Contract Documents or posted on the District's website at _____. Questions received less than **SEVEN (7)** calendar days prior to the date for opening Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

23. Addenda may also be issued to modify other parts of the Contract Documents as deemed advisable by the District.
24. All Addenda must be signed by the Project Architect and approved by the Division of the State Architect (CAC, Section 4-338 (b)).
25. Each Bidder must acknowledge each Addendum in its Bid Form and Proposal by number or its Bid shall be considered non-responsive. Each Addendum shall be part of the Contract Documents. A complete listing of Addenda may be secured from the District.
26. This Contract may include alternates. Alternates are defined as alternate products, materials, equipment, systems, methods, or major elements of the construction that may, at the District's option and under terms established in the Contract and pursuant to section 20103.8 of the Public Contract Code, be selected for the Work.
27. The District shall award the Contract, if it awards it at all, to the lowest responsive responsible bidder based on the criteria as indicated in the Notice to Bidders. In the event two or more responsible bidders submit identical bids, the District shall select the Bidder to whom to award the Contract by lot.
28. Discrepancies between written words and figures, or words and numeral, will be resolved in favor of figures or numerals.
29. Bidders in contention for contract awards shall be required to attend a Post Bid interview, which will be set within three (3) calendar days following bid opening. A duly authorized representative of the apparent low bidder is required to attend the Post Bid Interview, in person. The apparent low bidder's authorized representative(s) must have (1) knowledge of how the bid submitted was prepared, (2) the person responsible for supervising performance of the Work, and (3) the authority to bind the apparent low bidder. Failure to attend the Post Bid Interview as scheduled will be considered just cause for the District to reject the Bid as nonresponsive. .
30. Any bid protest by any Bidder regarding any other bid must be submitted in writing to the District, before 5:00 p.m. of the **THIRD (3rd)** business day following bid opening.
 - a. Only a Bidder who has actually submitted a bid, and who could be awarded the Contract if the bid protest is upheld, is eligible to submit a bid protest. Subcontractors are not eligible to submit bid protests. A Bidder may not rely on the bid protest submitted by another Bidder.
 - b. A bid protest must contain a complete statement of any and all bases for the protest and all supporting documentation. Materials submitted after the bid protest deadline will not be considered.
 - c. The protest must refer to the specific portions of all documents that form the basis for the protest.
 - (1) Without limitation to any other basis for protest, an inadvertent error in listing the California contractor's license number on the Designated

Subcontractors List shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive if the correct contractor's license number is submitted to the District within 24 hours after the bid opening and the corrected number corresponds with the submitted name and location for that subcontractor.

- (2) Without limitation to any other basis for protest, an inadvertent error listing an unregistered subcontractor shall not be grounds for filing a bid protest or grounds for considering the bid nonresponsive provided that any of the following apply:
 - (i) The subcontractor is registered prior to the bid opening.
 - (ii) The subcontractor is registered and has paid the penalty registration fee within 24 hours after the bid opening.
 - (iii) The subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.
 - d. The protest must include the name, address and telephone number of the person representing the protesting party.
 - e. The party filing the protest must concurrently transmit a copy of the protest and any attached documentation to all other parties with a direct financial interest that may be adversely affected by the outcome of the protest. Such parties shall include all other bidders or proposers who appear to have a reasonable prospect of receiving an award depending upon the outcome of the protest.
 - f. The procedure and time limits set forth in this paragraph are mandatory and are each bidder's sole and exclusive remedy in the event of bid protest. Failure to comply with these procedures shall constitute a waiver of any right to further pursue the bid protest, including filing a Government Code Claim or legal proceedings.
31. The Bidder to whom Contract is awarded shall execute and submit the following documents by 5:00 p.m. of the **SEVENTH (7th)** calendar day following the date of the Notice of Award. Failure to properly and timely submit these documents entitles District to reject the bid as nonresponsive.
- a. Agreement: To be executed by successful Bidder. Submit four (4) copies, each bearing an original signature.
 - b. Escrow of Bid Documentation: This must include all required documentation. See the document titled Escrow Bid Documentation for more information.
 - c. Performance Bond (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
 - d. Payment Bond (Contractor's Labor and Material Bond) (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.

- e. Insurance Certificates and Endorsements as required.
 - f. Workers' Compensation Certification.
 - g. Prevailing Wage and Related Labor Requirements Certification.
 - h. Drug-Free Workplace Certification.
 - i. Tobacco-Free Environment Certification.
 - j. Hazardous Materials Certification.
 - k. Lead-Based Materials Certification.
 - l. Imported Materials Certification.
 - m. Sex Offender Registration Act_Certification.
 - n. Buy American Certification.
 - o. Small Local Business Enterprise and Small Emerging Local Business Enterprise Program.
 - p. Registered Subcontractors List: Must include Department of Industrial Relations (DIR) registration number of each subcontractor for all tiers. Per Article 10 of the General Conditions, the complete submittal of Registered Subcontractors List is required within 10 days after the Notice to Proceed is issued.
32. Time for Completion: District may issue a Notice to Proceed within **NINETY (90)** days from the date of the Notice of Award. Once Contractor has received the Notice to Proceed, Contractor shall complete the Work within the period of time indicated in the Contract Documents.
- a. In the event that the District desires to postpone issuing the Notice to Proceed beyond this 90-day period, it is expressly understood that with reasonable notice to the Contractor, the District may postpone issuing the Notice to Proceed.
 - b. It is further expressly understood by Contractor that Contractor shall not be entitled to any claim of additional compensation as a result of the postponement of the issuance of the Notice to Proceed beyond a 90-day period. If the Contractor believes that a postponement of issuance of the Notice to Proceed will cause a hardship to the Contractor, the Contractor may terminate the Contract. Contractor's termination due to a postponement beyond this 90-day period shall be by written notice to District within **TEN (10)** calendar days after receipt by Contractor of District's notice of postponement.
 - c. It is further understood by the Contractor that in the event that Contractor terminates the Contract as a result of postponement by the District, the District shall only be obligated to pay Contractor for the Work that Contractor

had performed at the time of notification of postponement and which the District had in writing authorized Contractor to perform prior to issuing a Notice to Proceed.

- d. Should the Contractor terminate the Contract as a result of a notice of postponement, District shall have the authority to award the Contract to the next lowest responsive responsible bidder.
33. District reserves the right to reject any or all bids, including without limitation the right to reject any or all nonconforming, non-responsive, unbalanced, or conditional bids, to re-bid, and to reject the bid of any bidder if District believes that it would not be in the best interest of the District to make an award to that bidder, whether because the bid is not responsive or the bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by District. District also reserves the right to waive any inconsequential deviations or irregularities in any bid. For purposes of this paragraph, an "unbalanced bid" is one having nominal prices for some work items and/or enhanced prices for other work items.
34. It is the policy of the District that no qualified person shall be excluded from participating in, be denied the benefits of, or otherwise be subjected to discrimination in any consideration leading to the award of contract, based on race, color, gender, sexual orientation, political affiliation, age, ancestry, religion, marital status, national origin, medical condition or disability. The Successful Bidder and its subcontractors shall comply with applicable federal and state laws, including, but not limited to the California Fair Employment and Housing Act, beginning with Government Code section 12900, and Labor Code section 1735.
35. Prior to the award of Contract, District reserves the right to consider the responsibility of the Bidder. District may conduct investigations as District deems necessary to assist in the evaluation of any bid and to establish the responsibility, including, without limitation, qualifications and financial ability of Bidders, proposed subcontractors, suppliers, and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to District's satisfaction within the prescribed time.

END OF DOCUMENT

**SECTION 00 3100
AVAILABLE PROJECT INFORMATION**

PART 1 GENERAL

1.01 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders, but will not be part of the Contract Documents, as follows:
 - 1. Geotechnical Report: Entitled Geotechnical Design and Geological Hazards Evaluation Report, Child Development Center, Merritt College, 12500 Campus Drive, Oakland, California, dated December 22, 2019.
 - a. Report prepared by Terraphase Engineering Inc., Project No. 0034.005.0003.
 - b. Original copy is available for inspection at Owner's offices during normal business hours, or available with the Bidding Documents.
 - c. Original copy is available for inspection at the Architect's office during normal business hours.
 - d. Contractor is required to examine data provided.
 - e. Contractor is required to visit the site and become acquainted with existing conditions.
 - f. This report identifies properties of below grade conditions only at the locations of the borings and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
 - g. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
 - h. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Sum accruing to Owner.
 - i. Interpretation: This report is provided only for information and convenience. Owner and Architect disclaim responsibility for accuracy, true location and extent of soil conditions that have been evaluated by others. Owner and Architect further disclaim responsibility for interpretation of the report data by the Contractor; including but not limited to projecting soil bearing values, rock profiles, soil stability, and presence, level, and extent of underground water.
 - j. Applicable Requirements: Specific and variable recommendations contained in this document are subject to acceptance by Owner for incorporation in the Contract Documents prepared by Architect. Comply with requirements specified in the Contract Documents for earthwork, paving systems, and other applicable work scope items.
 - 2. California Geological Survey: Entitled Second Engineering Geology and Seismology Review for Merritt College - New Child Development Center Building 12500 Campus Drive, Oakland, California CGS Application No. 01-CGS4294, dated May 6, 2020.
 - a. Report prepared by California Department of Conservation.
 - b. Original copy is available for inspection at Owner's offices during normal business hours, or available with the Bidding Documents.
 - c. Original copy is available for inspection at the Architect's office during normal business hours.
 - d. Contractor is required to examine data provided.
 - e. Contractor is required to visit the site and become acquainted with existing conditions.
 - f. This report identifies properties of below grade conditions only at the locations of the borings and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
 - g. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
 - h. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the

design and construction of foundations will be made, with resulting credits or expenditures to the Contract Sum accruing to Owner.

- i. Interpretation: This report is provided only for information and convenience. Owner and Architect disclaim responsibility for accuracy, true location and extent of soil conditions that have been evaluated by others. Owner and Architect further disclaim responsibility for interpretation of the report data by the Contractor; including but not limited to projecting soil bearing values, rock profiles, soil stability, and presence, level, and extent of underground water.
- j. Applicable Requirements: Specific and variable recommendations contained in this document are subject to acceptance by Owner for incorporation in the Contract Documents prepared by Architect. Comply with requirements specified in the Contract Documents for earthwork, paving systems, and other applicable work scope items.

1.02 OTHER INFORMATION

- A. Bulk Asbestos Analysis Entitled Bulk Asbestos Analysis - PLM ARB 435.
 - 1. Report prepared by Micro Analytical Laboratories, Inc., Project No. 0034.005.0002
 - 2. Original copy is available for inspection at Owner's offices during normal business hours.
 - 3. Contractor is required to examine report data.
 - 4. Contractor should visit the site and become acquainted with existing conditions.
- B. ASCE 7 Hazards Report: Entitled ASCE 7 Hazards Report.
 - 1. Original copy is available for inspection at Owner's offices during normal business hours.
 - 2. Contractor is required to examine report data.
 - 3. Contractor should visit the site and become acquainted with existing conditions.
- C. Arborist Report: Entitled Second Merritt College Childcare Center Arborist Report, dated August 8, 2019.
 - 1. Report prepared by Bay Area Plant Consultants.
 - 2. Original copy is available for inspection at Owner's offices during normal business hours.
 - 3. Contractor is required to examine report data.
 - 4. Contractor should visit the site and become acquainted with existing conditions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

DOCUMENT 00 31 19

EXISTING CONDITIONS**1. Summary**

This document describes existing conditions at or near the Project, and use of information available regarding existing conditions. This document is **not** part of the Contract Documents. See General Conditions for definition(s) of terms used herein.

2. Reports and Information on Existing Conditions

- a. Documents providing a general description of the Site and conditions of the Work may have been collected by Peralta Community College District ("District"), its consultants, contractors, and tenants. These documents may, but are not required to, include previous contracts, contract specifications, tenant improvement contracts, as-built drawings, utility drawings, and information regarding underground facilities.
- b. Information regarding existing conditions may be inspected at the District offices or the Construction Manager's offices, if any, and copies may be obtained at cost of reproduction and handling upon Bidder's agreement to pay for such copies. These reports, documents, and other information are **not** part of the Contract Documents. These reports, documents, and other information do **not** excuse Contractor from fulfilling Contractor's obligation to independently investigate any or all existing conditions or from using reasonable prudent measures to avoid damaging existing improvements.
- c. Information regarding existing conditions may also be included in the Project Manual, but shall **not** be considered part of the Contract Documents.
- d. Prior to commencing this Work, Contractor and the District's representative shall survey the Site to document the condition of the Site. Contractor will record the survey in digital videotape format and provide an electronic copy to the District within fourteen (14) days of the survey.
- e. Contractor may also document any pre-existing conditions in writing, provided that both the Contractor and the District's representative agree on said conditions and sign a memorandum documenting the same.

3. Use of Information

- a. Information regarding existing conditions was obtained only for use of District and its consultants, contractors, and tenants for planning and design and is **not** part of the Contract Documents.
- b. District does not warrant, and makes no representation regarding, the accuracy or thoroughness of any information regarding existing conditions. Bidder represents and agrees that in submitting a bid it is not relying on any information regarding existing conditions supplied by District.

- c. Under no circumstances shall District be deemed to warrant or represent existing above-ground conditions, as-built conditions, or other actual conditions, verifiable by independent investigation. These conditions are verifiable by Bidder by the performance of its own independent investigation that Bidder must perform as a condition to bidding and Bidder should not and shall not rely on this information or any other information supplied by District regarding existing conditions.
- d. Any information shown or indicated in the reports and other data supplied herein with respect to existing underground facilities at or contiguous to the Project may be based upon information and data furnished to District by the District's employees and/or consultants or builders of such underground facilities or others. District does not assume responsibility for the completeness of this information, and Bidder is solely responsible for any interpretation or conclusion drawn from this information.
- e. District shall be responsible only for the general accuracy of information regarding underground facilities, and only for those underground facilities that are owned by District, and only where Bidder has conducted the independent investigation required of it pursuant to the Instructions to Bidders, and discrepancies are not apparent.

4. Investigations/Site Examinations

- a. Before submitting a Bid, each Bidder is responsible for conducting or obtaining any additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the Site or otherwise, that may affect cost, progress, performance, or furnishing of Work or that relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto or that Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of Contract Documents.
- b. On request, District will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies, as each Bidder deems necessary for submission of a Bid. Bidders must fill all holes and clean up and restore the Site to its former condition upon completion of its explorations, investigations, tests, and studies. Such investigations and Site examinations may be performed during any and all Site visits indicated in the Notice to Bidders and only under the provisions of the Contract Documents, including, but not limited to, proof of insurance and obligation to indemnify against claims arising from such work, and District's prior approval.

END OF DOCUMENT

DOCUMENT 00 31 32

GEOTECHNICAL DATA**1. Summary**

This document describes geotechnical data at or near the Project that is in the District's possession available for Contractor's review, and use of data resulting from various investigations. This document is **not** part of the Contract Documents. See General Conditions for definition(s) of terms used herein.

2. Geotechnical Reports

- a. Geotechnical reports may have been prepared for and around the Site and/or in connection with the Work by soil investigation engineers hired by Peralta Community College District ("District"), and its consultants, contractors, and tenants.
- b. Geotechnical reports may be inspected at the District offices or the Construction Manager's offices, if any, and copies may be obtained at cost of reproduction and handling upon Bidder's agreement to pay for such copies. These reports are **not** part of the Contract Documents.
- c. The following reports and drawings of physical conditions that may relate to the Project are for reference only and can be made available to the bidders:

- (1) Geotechnical Design Report-0034 Peralta-22Dec19
- (2) 201908 PCCD 2nd Childcare Center Report
- (3) ASCEDesignHazardsReport 2016 Site Class C
- (4) Merritt College 01-CGS4294_Second Review

3. Use of Data

- a. Geotechnical data were obtained only for use of District and its consultants, contractors, and tenants for planning and design and are **not** a part of Contract Documents.
- b. Except as expressly set forth below, District does not warrant, and makes no representation regarding, the accuracy or thoroughness of any geotechnical data. Bidder represents and agrees that in submitting a Bid it is not relying on any geotechnical data supplied by District, except as specifically allowed below.
- c. Under no circumstances shall District be deemed to make a warranty or representation of existing above ground conditions, as-built conditions, geotechnical conditions, or other actual conditions verifiable by independent investigation. These conditions are verifiable by Bidder by the performance of its own independent investigation that Bidder should perform as a condition to bidding and Bidder must not and shall not rely on information supplied by District.

4. Limited Reliance Permitted on Certain Information

- a. Reference is made herein for identification of:

Reports of explorations and tests of subsurface conditions at or contiguous to the Site that have been utilized by District in preparation of the Contract Documents.

Drawings of physical conditions in or relating to existing subsurface structures (except underground facilities) that are at or contiguous to the Site and have been utilized by District in preparation of the Contract Documents.

- b. Bidder may rely upon the general accuracy of the "technical data" contained in the reports and drawings identified above, but only insofar as it relates to subsurface conditions, provided Bidder has conducted the independent investigation required pursuant to Instructions to Bidders, and discrepancies are not apparent. The term "technical data" in the referenced reports and drawings shall be limited as follows:
- (1) The term "technical data" shall include actual reported depths, reported quantities, reported soil types, reported soil conditions, and reported material, equipment or structures that were encountered during subsurface exploration. The term "technical data" does not include, and Bidder may not rely upon, any other data, interpretations, opinions or information shown or indicated in such drawings or reports that otherwise relate to subsurface conditions or described structures.
 - (2) The term "technical data" shall not include the location of underground facilities.
 - (3) Bidder may not rely on the completeness of reports and drawings for the purposes of bidding or construction. Bidder may rely upon the general accuracy of the "technical data" contained in such reports or drawings.
 - (4) Bidder is solely responsible for any interpretation or conclusion drawn from any "technical data" or any other data, interpretations, opinions, or information provided in the identified reports and drawings.

5. Investigations/Site Examinations

- a. Before submitting a Bid, each Bidder is responsible for conducting or obtaining any additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the Site or otherwise, that may affect cost, progress, performance, or furnishing of Work or that relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto or that Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of Contract Documents.

- b. On request, District will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies, as each Bidder deems necessary for submission of a Bid. Bidders must fill all holes and clean up and restore the Site to its former condition upon completion of its explorations, investigations, tests, and studies. Such investigations and Site examinations may be performed during any and all Site visits indicated in the Notice to Bidders and only under the provisions of the Contract Documents, including, but not limited to, proof of insurance and obligation to indemnify against claims arising from such work, and District's prior approval.

END OF DOCUMENT

DOCUMENT 00 41 13
BID FORM AND PROPOSAL

To: Peralta Community College District ("District" or "Owner")

From: _____
(Proper Name of Bidder)

The undersigned declares that Bidder has read and understands the Contract Documents, including, without limitation, the Notice to Bidders and the Instructions to Bidders, and agrees and proposes to furnish all necessary labor, materials, and equipment to perform and furnish all work in accordance with the terms and conditions of the Contract Documents, including, without limitation, the Drawings and Specifications of Bid No. _ _____, for the following project known as:

Merritt College New Child Development Center (Increments #1 & #2)

("Project" or "Contract") and will accept in full payment for that Work the following total lump sum amount, all taxes included:

_____ dollars	\$ _____
Base Bid for Increment #1	
_____ dollars	\$ _____
Base Bid for Increment #2*	
_____ dollars	\$ _____
<i>TOTAL BASE BID = (Inc. #1 + Inc. #2)</i>	
* The Base Bid for Increment #2 cannot exceed 25% of the Total Base Bid.	
<i>Bidder acknowledges and agrees that the lowest responsive, responsible bidder will be determined based on the Base Bid for Increment #1 only.</i>	

Alternate Pricing

	dollars	\$ _____
Deductive Alternate #1 (Increment #1)		
Landscape:		
1. Item L-1: Delete fence along line 13, between lines BB and EE. (Drawings S/L-402, L/LD-101)		
	dollars	\$ _____
Deductive Alternate #2 (Increment #1)		
Structural:		
1. Item S-1: Delete exterior wall elevation. (Drawing 2-S/S-402)		
2. Item S-2: Delete details 14, 17. (Drawing L/S-510)		
	dollars	\$ _____
Deductive Alternate #3 (Increment #1)		
Architectural:		
1. Item A-1: Delete temporary walls along Lines EE, DD.5, 12.5. (Drawings S/A-201, S/A-202)		
2. Item A-2: Delete roofing, gutter, RWL above Room 107. (Drawing S/A-201)		
3. Item a-3: Delete Door 121A, frame, hardware. (Drawing S/A-102)		
4. Item A-4: Delete concrete sidewalk outside Door 121A. (Drawing S/A-041)		
5. Item A-5: Eliminate intermediate roofing slopes where temporary wall occurs. (Drawing S/A -103)		
	dollars	\$ _____
Deductive Alternate #4 (Increment #1)		
Mechanical / Electrical:		
1. Item M-1: Remove all duct and pipe caps at Line EE, Levels 1 and 2. (Drawings S/M-101, S/M-102, S/M-121, S/M-122)		
2. Item M-2: Lower grade on cable from Category 6A to Category 6. (Drawing S/T-001, L/T-001)		
3. Item M-3: Reduce wireless access points in classrooms from 2 to 1. (Drawings S/T-111, S/T-112, L/T-111, L/T-112)		
4. Item M-4: Delete card reader at Door 121A. (Drawing S/E-101)		

Descriptions of deductive alternates are primarily scope definitions and do not necessarily detail the full range of materials and processes needed to complete the construction.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

Additional Detail Regarding Calculation of Base Bid

1. The undersigned has reviewed the Work outlined in the Contract Documents and fully understands the scope of Work required in this Proposal, understands the construction and project management function(s) is described in the Contract Documents, and that each Bidder who is awarded a contract shall be in fact a prime contractor, not a subcontractor, to the District, and agrees that its Proposal, if accepted by the District, will be the basis for the Bidder to enter into a contract with the District in accordance with the intent of the Contract Documents.
2. The undersigned has notified the District in writing of any discrepancies or omissions or of any doubt, questions, or ambiguities about the meaning of any of the Contract Documents, and has contacted the Construction Manager before bid date to verify the issuance of any clarifying Addenda.
3. The undersigned agrees to commence work under this Contract on the date established in the Contract Documents and to complete all work within the time specified in the Contract Documents.
4. The liquidated damages clause of the General Conditions and Agreement is hereby acknowledged.
5. It is understood that the District reserves the right to reject this bid and that the bid shall remain open to acceptance and is irrevocable for a period of ninety (90) days.
6. The following documents are attached hereto:
 - Bid Bond on the District's form or other security
 - Designated Subcontractors List
 - Site Visit Certification
 - Non-Collusion Declaration
 - Iran Contracting Act Certification
 - SLBE/SELBE Self Certification Affidavit

7. Receipt and acceptance of the following Addenda is hereby acknowledged:

No. _____, Dated _____	No. _____, Dated _____
No. _____, Dated _____	No. _____, Dated _____
No. _____, Dated _____	No. _____, Dated _____

8. Bidder acknowledges that the license required for performance of the Work is a _____ license.
9. Bidder hereby certifies that Bidder is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work.

10. Bidder specifically acknowledges and understands that if it is awarded the Contract, that it shall perform the Work of the Project while complying with all requirements of the Department of Industrial Relations.
11. Bidder hereby certifies that its bid includes sufficient funds to permit Bidder to comply with all local, state or federal labor laws or regulations during the Project, including payment of prevailing wage, and that Bidder will comply with the provisions of Labor Code section 2810(d) if awarded the Contract.
12. Bidder agrees to comply with all requirements of the Project Labor Agreement.
13. The Bidder represents that it is competent, knowledgeable, and has special skills with respect to the nature, extent, and inherent conditions of the Work to be performed. Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the Work that may create, during the Work, unusual or peculiar unsafe conditions hazardous to persons and property.
14. Bidder expressly acknowledges that it is aware of such peculiar risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the Work with respect to such hazards.
15. Bidder expressly acknowledges that it is familiar with and capable of complying with applicable federal, State, and local requirements relating to COVID-19 or other public health emergency/epidemic/pandemic including, if required, preparing, posting, and implementing a Social Distancing Protocol.
16. Bidder expressly acknowledges that it is aware that if a false claim is knowingly submitted (as the terms "claim" and "knowingly" are defined in the California False Claims Act, Gov. Code, § 12650 et seq.), the District will be entitled to civil remedies set forth in the California False Claim Act. It may also be considered fraud and the Contractor may be subject to criminal prosecution.
17. The undersigned Bidder certifies that it is, at the time of bidding, and shall be throughout the period of the Contract, licensed by the State of California to do the type of work required under the terms of the Contract Documents and registered as a public works contractor with the Department of Industrial Relations. Bidder further certifies that it is regularly engaged in the general class and type of work called for in the Contract Documents.

Furthermore, Bidder hereby certifies to the District that all representations, certifications, and statements made by Bidder, as set forth in this bid form, are true and correct and are made under penalty of perjury.

Dated this _____ day of _____ 20 ____

Name of Bidder: _____

Type of Organization: _____

Signed by: _____

Title of Signer: _____

Address of Bidder: _____

Taxpayer Identification No. of Bidder: _____

Telephone Number: _____

Fax Number: _____

E-mail: _____ Web Page: _____

Contractor's License No(s): No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

Public Works Contractor Registration No.: _____

END OF DOCUMENT

DOCUMENT 00 43 13

BID BOND

(Note: If Bidder is providing a bid bond as its bid security, Bidder must use this form, NOT a surety company form.)

KNOW ALL PERSONS BY THESE PRESENTS:

That the undersigned, _____, as Principal ("Principal"),
and, _____, as Surety ("Surety"), a corporation organized and existing under and by virtue of the laws of the State of ____ and authorized to do business as a surety in the State of California, are held and firmly bound unto the Peralta Community College District ("District") of Alameda County, State of California, as Obligee, in an amount equal to ten percent (10%) of the Base Bid plus alternates, in the sum of

_____ Dollars (\$ _____)

lawful money of the United States of America, for the payment of which sum well and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted a bid to the District for all Work specifically described in the accompanying bid for the following project: _____ ("Project" or "Contract").

NOW, THEREFORE, if the Principal is awarded the Contract and, within the time and manner required under the Contract Documents, after the prescribed forms are presented to Principal for signature, enters into a written contract, in the prescribed form in accordance with the bid, and files two bonds, one guaranteeing faithful performance and the other guaranteeing payment for labor and materials as required by law, and meets all other conditions to the Contract between the Principal and the District becoming effective, or if the Principal shall fully reimburse and save harmless the District from any damage sustained by the District through failure of the Principal to enter into the written contract and to file the required performance and labor and material bonds, and to meet all other conditions to the Contract between the Principal and the District becoming effective, then this obligation shall be null and void; otherwise, it shall be and remain in full force and effect. The full payment of the sum stated above shall be due immediately if Principal fails to execute the Contract within seven (7) days of the date of the District's Notice of Award to Principal.

Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or the call for bids, or to the work to be performed thereunder, or the specifications accompanying the same, shall in any way affect its obligation under this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or the call for bids, or to the work, or to the specifications.

In the event suit is brought upon this bond by the District and judgment is recovered, the Surety shall pay all costs incurred by the District in such suit, including a reasonable attorneys' fee to be fixed by the Court.

If the District awards the bid, the security of unsuccessful bidder(s) shall be returned within sixty (60) days from the time the award is made. Unless otherwise required by law, no bidder may withdraw its bid for ninety (90) days after the date of the bid opening.

IN WITNESS WHEREOF, this instrument has been duly executed by the Principal and Surety above named, on the _____ day of _____, 20__.

Principal

By

Surety

By

Name of California Agent of Surety

Address of California Agent of Surety

Telephone Number of California Agent of Surety

Bidder must attach Power of Attorney and Certificate of Authority for Surety and a Notarial Acknowledgment for all Surety's signatures. The California Department of Insurance must authorize the Surety to be an admitted Surety Insurer.

END OF DOCUMENT

DOCUMENT 00 43 36

DESIGNATED SUBCONTRACTORS LIST
(Public Contract Code Sections 4100-4114)

PROJECT: Merritt College New Child Development Center (CDC)_____

Bidder acknowledges and agrees that it must clearly set forth below the name, location and California contractor license number of each subcontractor who will perform work or labor or render service to the Bidder in or about the construction of the Work or who will specially fabricate and install a portion of the Work according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of one percent (0.5%) of Bidder's total Base Bid and the kind of Work that each will perform. Vendors or suppliers of materials only do not need to be listed.

Bidder acknowledges and agrees that, if Bidder fails to list as to any portion of Work, or if Bidder lists more than one subcontractor to perform the same portion of Work, Bidder must perform that portion itself or be subjected to penalty under applicable law. In case more than one subcontractor is named for the same kind of Work, state the portion of the kind of Work that each subcontractor will perform.

If alternate bid(s) is/are called for and Bidder intends to use subcontractors different from or in addition to those subcontractors listed for work under the Base Bid, Bidder must list subcontractors that will perform Work in an amount in excess of one half of one percent (0.5%) of Bidder's total Base Bid, plus alternate(s).

If further space is required for the list of proposed subcontractors, attach additional copies of page 2 showing the required information, as indicated below.

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Subcontractor Name: _____

CA Cont. Lic. #: _____ Location: _____

Portion of Work: _____

Date: _____

Proper Name of Bidder: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 01

SITE VISIT CERTIFICATION

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID
IF SITE VISIT WAS MANDATORY

PROJECT: Merritt College New Child Development Center (CDC)_____

Check option that applies:

_____ I certify that I visited the Site of the proposed Work, received the attached pages of information, and became fully acquainted with the conditions relating to construction and labor. I fully understand the facilities, difficulties, and restrictions attending the execution of the Work under contract.

_____ I certify that _____ (Bidder's representative) visited the Site of the proposed Work, received the attached ___ pages of information, and became fully acquainted with the conditions relating to construction and labor. The Bidder's representative fully understood the facilities, difficulties, and restrictions attending the execution of the Work under contract.

Bidder fully indemnifies the Peralta Community College District, its Architect, its Engineers, its Construction Manager, and all of their respective officers, agents, employees, and consultants from any damage, or omissions, related to conditions that could have been identified during my visit and/or the Bidder's representative's visit to the Site.

I certify under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Date: _____

Proper Name of Bidder: _____

Signature: _____

Print Name: _____

Title: _____

ATTACHMENTS:

- 1.**
- 2.**
- 3.**

END OF DOCUMENT

DOCUMENT 00 45 19

NON-COLLUSION DECLARATION
(Public Contract Code Section 7106)

The undersigned declares:

I am the _____ of _____, the party making the foregoing bid.
[Title] [Name of Firm]

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____,
[Date]

at _____, _____.
[City] [State]

Date: _____

Proper Name of Bidder: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 19.01

IRAN CONTRACTING ACT CERTIFICATION
(Public Contract Code Sections 2202-2208)

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
 between the Peralta Community College District ("District") and
 ("Contractor" or "Bidder")
 ("Contract" or "Project").

Prior to bidding on or submitting a proposal for a contract for goods or services of \$1,000,000 or more, the bidder/proposer must submit this certification pursuant to Public Contract Code section 2204.

The bidder/proposer must complete **ONLY ONE** of the following two options. To complete OPTION 1, check the corresponding box **and** complete the certification below. To complete OPTION 2, check the corresponding box, complete the certification below, and attach documentation demonstrating the exemption approval.

- OPTION 1.** Bidder/Proposer is not on the current list of persons engaged in investment activities in Iran created by the California Department of General Services ("DGS") pursuant to Public Contract Code section 2203(b), and we are not a financial institution extending twenty million dollars (\$20,000,000) or more in credit to another person, for 45 days or more, if that other person will use the credit to provide goods or services in the energy sector in Iran and is identified on the current list of persons engaged in investment activities in Iran created by DGS.
- OPTION 2.** Bidder/Proposer has received a written exemption from the certification requirement pursuant to Public Contract Code sections 2203(c) and (d). *A copy of the written documentation demonstrating the exemption approval is included with our bid/proposal.*

CERTIFICATION:

I, the official named below, CERTIFY UNDER PENALTY OF PERJURY, that I am duly authorized to legally bind the bidder/proposer to the OPTION selected above. This certification is made under the laws of the State of California.

<i>Vendor Name/Financial Institution (Printed)</i>	<i>Federal ID Number (or n/a)</i>
<i>By (Authorized Signature)</i>	
<i>Printed Name and Title of Person Signing</i>	<i>Date Executed</i>

END OF DOCUMENT

DOCUMENT 00 45 26

WORKERS' COMPENSATION CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
between the Peralta Community College District
("District") and ("Contractor" or "Bidder")
("Contract" or "Project").

Labor Code section 3700, in relevant part, provides:

Every employer except the State shall secure the payment of compensation in one or more of the following ways:

- a. By being insured against liability to pay compensation by one or more insurers duly authorized to write compensation insurance in this state; and/or
- b. By securing from the Director of Industrial Relations a certificate of consent to self-insure, which may be given upon furnishing proof satisfactory to the Director of Industrial Relations of ability to self-insure and to pay any compensation that may become due to his employees.

I am aware of the provisions of section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the Work of this Contract.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

(In accordance with Labor Code sections 1860 and 1861, the above certificate must be signed and filed with the awarding body prior to performing any Work under this Contract.)

END OF DOCUMENT

DOCUMENT 00 45 46. 01

**PREVAILING WAGE AND
RELATED LABOR REQUIREMENTS CERTIFICATION**

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
between the Peralta Community College District
("District") and ("Contractor")
or "Bidder") ("Contract" or "Project").

I hereby certify that I will conform to the State of California Public Works Contract requirements regarding prevailing wages, benefits, on-site audits with 48-hours' notice, payroll records, and apprentice and trainee employment requirements, for all Work on the above Project including, without limitation, labor compliance monitoring and enforcement by the Department of Industrial Relations.

Date: _____
Proper Name of Contractor: _____
Signature: _____
Print Name: _____
Title: _____

END OF DOCUMENT

DOCUMENT 00 45 46.03

DRUG-FREE WORKPLACE CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
 between the Peralta Community College District
 (“District”) and (“Contractor”
 or “Bidder”) (“Contract” or “Project”).

This Drug-Free Workplace Certification form is required from the successful Bidder pursuant to Government Code section 8350 et seq., the Drug-Free Workplace Act of 1990. The Drug-Free Workplace Act of 1990 requires that every person or organization awarded a contract or grant for the procurement of any property or service from any state agency must certify that it will provide a drug-free workplace by doing certain specified acts. In addition, the Act provides that each contract or grant awarded by a state agency may be subject to suspension of payments or termination of the contract or grant, and the contractor or grantee may be subject to debarment from future contracting, if the contracting agency determines that specified acts have occurred.

The District is not a “state agency” as defined in the applicable section(s) of the Government Code, but the District is a local agency and community college district under California law and requires all contractors on District projects to comply with the provisions and requirements of the Drug-Free Workplace Act of 1990.

Contractor must also comply with the provisions of Health & Safety Code section 11362.3 which prohibits the consumption or possession of cannabis or cannabis products in any public place, including on campus.

Contractor shall certify that it will provide a drug-free workplace by doing all of the following:

- a. Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited in the person’s or organization’s workplace and specifying actions which will be taken against employees for violations of the prohibition.
- b. Establishing a drug-free awareness program to inform employees about all of the following:
 - (1) The dangers of drug abuse in the workplace.
 - (2) The person’s or organization’s policy of maintaining a drug-free workplace.
 - (3) The availability of drug counseling, rehabilitation, and employee-assistance programs.
 - (4) The penalties that may be imposed upon employees for drug abuse violations.

- c. Requiring that each employee engaged in the performance of the contract or grant be given a copy of the statement required above, and that, as a condition of employment on the contract or grant, the employee agrees to abide by the terms of the statement.

I, the undersigned, agree to fulfill the terms and requirements of Government Code section 8355 listed above and will publish a statement notifying employees concerning (a) the prohibition of controlled substance at the workplace, (b) establishing a drug-free awareness program, and (c) requiring that each employee engaged in the performance of the Contract be given a copy of the statement required by section 8355(a), and requiring that the employee agree to abide by the terms of that statement.

I also understand that if the District determines that I have either (a) made a false certification herein, or (b) violated this certification by failing to carry out the requirements of section 8355, that the Contract awarded herein is subject to termination, suspension of payments, or both. I further understand that, should I violate the terms of the Drug-Free Workplace Act of 1990, I may be subject to debarment in accordance with the requirements of the aforementioned Act.

I acknowledge that I am aware of the provisions of and hereby certify that I will adhere to the requirements of the Drug-Free Workplace Act of 1990 and Health and Safety Code section 11362.3.

Date: _____
Proper Name of Contractor: _____
Signature: _____
Print Name: _____
Title: _____

END OF DOCUMENT

DOCUMENT 00 45 46.04

TOBACCO-FREE ENVIRONMENT CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
between the Peralta Community College District
("District") and ("Contractor")
or "Bidder") ("Contract" or "Project").

This Tobacco-Free Environment Certification form is required from the successful Bidder.

Pursuant to, without limitation, 20 U.S.C. section 6083, Labor Code section 6400 et seq., Health & Safety Code section 104350 et seq., Business and Professions Code section 22950 et seq., and District Board policies, all District sites, including the Project site, are tobacco-free environments. Smoking and the use of tobacco products by all persons is prohibited on or in District property. District property includes school buildings, school grounds, school-owned vehicles and vehicles owned by others while on District property. The prohibition on smoking includes the use of any electronic smoking device that creates an aerosol or vapor, in any manner or in any form, and the use of any oral smoking device for the purpose of circumventing the prohibition of tobacco smoking. Further, Health & Safety Code section 11362.3 prohibits the smoking or use of cannabis or cannabis products in any place where smoking tobacco is prohibited.

I acknowledge that I am aware of the District's policy regarding tobacco-free environments at District sites, including the Project site and hereby certify that I will adhere to the requirements of that policy and not permit any of my firm's employees, agents, subcontractors, or my firm's subcontractors' employees or agents, to use tobacco and/or smoke on the Project site.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 46.05

HAZARDOUS MATERIALS CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
between the Peralta Community College District ("District")
and ("Contractor" or "Bidder")
("Contract" or "Project").

1. Contractor hereby certifies that no asbestos, or asbestos-containing materials, polychlorinated biphenyl (PCB), or any material listed by the federal or state Environmental Protection Agency or federal or state health agencies as a hazardous material, or any other material defined as being hazardous under federal or state laws, rules, or regulations, ("New Hazardous Material"), shall be furnished, installed, or incorporated in any way into the Project or in any tools, devices, clothing, or equipment used to affect any portion of Contractor's work on the Project for District.
2. Contractor further certifies that it has instructed its employees with respect to the above-mentioned standards, hazards, risks, and liabilities.
3. Asbestos and/or asbestos-containing material shall be defined as all items containing but not limited to chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite. Any or all material containing greater than one-tenth of one percent (0.1%) asbestos shall be defined as asbestos-containing material.
4. Any disputes involving the question of whether or not material is New Hazardous Material shall be settled by electron microscopy or other appropriate and recognized testing procedure, at the District's determination. The costs of any such tests shall be paid by Contractor if the material is found to be New Hazardous Material.
5. All Work or materials found to be "New Hazardous Material" or Work or material installed with equipment containing "New Hazardous Material" will be immediately rejected and this Work will be removed at Contractor's expense at no additional cost to the District.
6. Contractor has read and understood the document titled Hazardous Materials Procedures & Requirements, and shall comply with all the provisions outlined therein. Contractor certifies that it is knowledgeable of, and shall comply with, all laws applicable to the Work, including, but not limited to, all federal, state, and local laws, statutes, standards, rules, regulations, and ordinances applicable to the Work.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 46.06

LEAD-BASED MATERIALS CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
 between the Peralta Community College District ("District")
 and ("Contract" or "Project"). ("Contractor" or "Bidder")

This certification provides notice to the Contractor that:

- (1) Contractor's work may disturb lead-containing building materials.
- (2) Contractor shall notify the District if any work may result in the disturbance of lead-containing building materials.
- (3) Contractor shall comply with the Renovation, Repair and Painting Rule, if lead-based paint is disturbed in a six-square-foot or greater area indoors or a 20-square-foot or greater area outdoors.

1. Lead as a Health Hazard

Lead poisoning is recognized as a serious environmental health hazard facing children today. Even at low levels of exposure, much lower than previously believed, lead can impair the development of a child's central nervous system, causing learning disabilities, and leading to serious behavioral problems. Lead enters the environment as tiny lead particles and lead dust disburse when paint chips, chalks, peels, wears away over time, or is otherwise disturbed. Ingestion of lead dust is the most common pathway of childhood poisoning; lead dust gets on a child's hands and toys and then into a child's mouth through common hand-to-mouth activity. Exposures may result from construction or remodeling activities that disturb lead paint, from ordinary wear and tear of windows and doors, or from friction on other surfaces.

Ordinary construction and renovation or repainting activities carried out without lead-safe work practices can disturb lead-based paint and create significant hazards. Improper removal practices, such as dry scraping, sanding, or water blasting painted surfaces, are likely to generate high volumes of lead dust.

Because the Contractor and its employees will be providing services for the District, and because the Contractor's work may disturb lead-containing building materials, CONTRACTOR IS HEREBY NOTIFIED of the potential presence of lead-containing materials located within certain buildings utilized by the District. All school buildings built prior to 1978 are presumed to contain some lead-based paint until sampling proves otherwise.

2. Overview of Law

Both the Federal Occupational Safety and Health Administration ("Fed/OSHA") and the California Division of Occupational Safety and Health ("Cal/OSHA") have

implemented safety orders applicable to all construction work where a contractor's employee may be occupationally exposed to lead.

The OSHA Regulations apply to all construction work where a contractor's employee may be occupationally exposed to lead. The OSHA Regulations contain specific and detailed requirements imposed on contractors subject to those regulations. The OSHA Regulations define construction work as work for construction, alteration, and/or repair, including painting and decorating. Regulated construction work includes, but is not limited to, the following:

- a. Demolition or salvage of structures where lead or materials containing lead are present;
- b. Removal or encapsulation of materials containing lead;
- c. New construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead;
- d. Installation of products containing lead;
- e. Lead contamination/emergency cleanup;
- f. Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed; and
- g. Maintenance operations associated with the construction activities described in the subsection.

Because it is assumed by the District that all painted surfaces (interior as well as exterior) within the District contain some level of lead, it is imperative that the Contractor, its workers and subcontractors fully and adequately comply with all applicable laws, rules and regulations governing lead-based materials (including title 8, California Code of Regulations, section 1532.1).

Contractor shall notify the District if any Work may result in the disturbance of lead-containing building materials. Any and all Work that may result in the disturbance of lead-containing building materials shall be coordinated through the District. A signed copy of this Certification shall be on file prior to beginning Work on the Project, along with all current insurance certificates.

3. Renovation, Repair and Painting Rule, Section 402(c)(3) of the Toxic Substances Control Act

The EPA requires lead safe work practices to reduce exposure to lead hazards created by renovation, repair and painting activities that disturb lead-based paint. Pursuant to the Renovation, Repair and Painting Rule (RRP), renovations in homes, childcare facilities, and schools built prior to 1978 must be conducted by certified renovations firms, using renovators with training by a EPA-accredited training provider, and fully and adequately complying with all applicable laws, rules and regulations governing lead-based materials, including those rules and regulations

appearing within title 40 of the Code of Federal Regulations as part 745 (40 CFR 745).

The RRP requirements apply to all contractors who disturb lead-based paint in a six-square-foot or greater area indoors or a 20-square-foot or greater area outdoors. If a DPH-certified inspector or risk assessor determines that a home constructed before 1978 is lead-free, the federal certification is not required for anyone working on that particular building.

4. Contractor's Liability

If the Contractor fails to comply with any applicable laws, rules, or regulations, and that failure results in a site or worker contamination, the Contractor will be held solely responsible for all costs involved in any required corrective actions, and shall defend, indemnify, and hold harmless the District, pursuant to the indemnification provisions of the Contract, for all damages and other claims arising therefrom.

If lead disturbance is anticipated in the Work, only persons with appropriate accreditation, registrations, licenses, and training shall conduct this Work.

It shall be the responsibility of the Contractor to properly dispose of any and all waste products, including, but not limited to, paint chips, any collected residue, or any other visual material that may occur from the prepping of any painted surface. It will be the responsibility of the Contractor to provide the proper disposal of any hazardous waste by a certified hazardous waste hauler. This company shall be registered with the Department of Transportation (DOT) and shall be able to issue a current manifest number upon transporting any hazardous material from any school site within the District.

The Contractor shall provide the District with any sample results prior to beginning Work, during the Work, and after the completion of the Work. The District may request to examine, prior to the commencement of the Work, the lead training records of each employee of the Contractor.

THE CONTRACTOR HEREBY ACKNOWLEDGES, UNDER PENALTY OF PERJURY, THAT IT:

1. HAS RECEIVED NOTIFICATION OF POTENTIAL LEAD-BASED MATERIALS ON THE OWNER'S PROPERTY;
2. IS KNOWLEDGEABLE REGARDING AND WILL COMPLY WITH ALL APPLICABLE LAWS, RULES, AND REGULATIONS GOVERNING WORK WITH, AND DISPOSAL, OF LEAD.

THE UNDERSIGNED WARRANTS THAT HE/SHE HAS THE AUTHORITY TO SIGN ON BEHALF OF AND BIND THE CONTRACTOR. THE DISTRICT MAY REQUIRE PROOF OF SUCH AUTHORITY.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title:

END OF DOCUMENT

DOCUMENT 00 45 46.07

IMPORTED MATERIALS CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
between the Peralta Community College District ("District")
and ("Contract" or "Project"). ("Contractor" or "Bidder")

This form shall be executed by all entities that, in any way, provide or deliver and/or supply any soils, aggregate, or related materials ("Fill") to the Project Site and shall be provided to the District at least ten (10) days before delivery. All Fill shall satisfy all requirements of any environmental review of the Project performed pursuant to the statutes and guidelines of the California Environmental Quality Act, section 21000 et seq. of the Public Resources Code ("CEQA"), and all requirements of section 17210 et seq. of the Education Code, including requirements for a Phase I environmental assessment acceptable to the State of California Community Colleges Chancellor's Office and Department of Toxic Substances Control.

Certification of: Delivery Firm/Transporter Supplier Manufacturer
 Wholesaler Broker Retailer
 Distributor Other _____

Type of Entity Corporation General Partnership
 Limited Partnership Limited Liability Company
 Sole Proprietorship Other _____

Name of firm ("Firm"): _____

Mailing address: _____

Addresses of branch office used for this Project: _____

If subsidiary, name and address of parent company: _____

By my signature below, I hereby certify that I am aware of section 25260 of the Health and Safety Code and the sections referenced therein regarding the definition of hazardous material. I further certify on behalf of the Firm that all soils, aggregates, or related materials provided, delivered, and/or supplied or that will be provided, delivered, and/or supplied by this Firm to the Project Site are free of any and all hazardous material as defined in section 25260 of the Health and Safety Code. I further certify that I am authorized to make this certification on behalf of the Firm.

Date: _____

Proper Name of Firm: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 46.08

SEX OFFENDER REGISTRATION ACT CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
and between the Peralta Community College District ("District")
("Contract" or "Project"). ("Contractor" or "Bidder")

This certification provides notice to the Contractor that:

- Penal Code section 290.001 requires every person required to register pursuant to sections 290 to 290.009, inclusive, of the Sex Offender Registration Act who is carrying on a vocation at the community college for more than fourteen (14) days, or for an aggregate period exceeding thirty (30) days in a calendar year, shall, in addition to the registration required by the Sex Offender Registration Act, register with the campus police department within five (5) working days of commencing employment at that community college on a form as may be required by the Department of Justice. The terms "employed or carries on a vocation" include employment whether or not financially compensated, volunteered, or performed for government or educational benefit.
- If the community college has no campus police department, the registrant shall instead register with the police of the city in which the campus is located or the sheriff of the county in which the campus is located if the campus is located in an unincorporated area or in a city that has no police department, on a form as may be required by the Department of Justice.
- The registrant shall also notify the campus police department within five (5) working days of ceasing to be employed, or ceasing to carry on a vocation, at the community college.

Contractor hereby acknowledges, under penalty of perjury, that it is aware of the provisions of section 290.001 of the Penal Code, and it will provide notice of the above provisions to all of its employees, subcontractors, and employees of subcontractors regardless of whether they are designated as employees or acting as independent contractors of the Contractor at least five (5) working days before commencing the performance of the Work of this Contract.

THE UNDERSIGNED WARRANTS THAT HE/SHE HAS THE AUTHORITY TO SIGN ON BEHALF OF AND BIND THE CONTRACTOR. THE DISTRICT MAY REQUIRE PROOF OF SUCH AUTHORITY.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 46.09

BUY AMERICAN CERTIFICATION

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/PROJECT NO. 2425:
between the Peralta Community College District
("District") and ("Contractor"
or "Bidder") ("Contract" or "Project").

Federal regulations require that all of the iron, steel, and manufactured goods used in projects for the construction, installation, repairs, renovation, modernization, or maintenance of a public building or public work funded in part or in whole by federal stimulus funds, with the exception of projects funded by Qualified School Construction Bonds, be produced in the United States of America, unless a federal department waives this requirement because (1) it is inconsistent with the public interest, (2) the goods are not produced in sufficient quantities or of satisfactory quality in the United States, or (3) the requirement would increase the cost of the Project overall by more than twenty-five percent (25%) ("Buy American").

Contractor shall submit this Certification with its executed agreement, identifying the steps Contractor will take to use goods produced in the United States of America in carrying out this Contract. Bidder should not submit this form with its bid.

Contractor shall retain a copy of this form and may be subject to a future audit.

CERTIFICATION

On behalf of Contractor, I represent and covenant that Contractor will use on the Project only iron, steel and manufactured goods produced in the United States of America except goods for which a federal department has waived this requirement.

I, _____, certify that I am the Contractor's _____ and that the representations and covenants made herein are true and correct. In making this certification, I am aware of section 12650 et seq. of the Government Code providing for the imposition of treble damages for making false claims.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT



Peralta Community College District

SMALL LOCAL BUSINESS ENTERPRISE AND SMALL EMERGING LOCAL BUSINESS ENTERPRISE PROGRAM

The District is committed to ensure equal opportunity and equitable treatment in awarding and managing its public contracts and has established an annual overall program goal of twenty-five percent participation for small local businesses. To facilitate opportunities for small local business, the District will use a maximum 5% bidding preference for SLBE and SELBE firms. The preference is only used for computation purposes to determine the winning bidder, the contract is awarded at the actual bid amount. Please review the following guidelines to see if your firm qualifies for the preference.

The 5% bidding preference for an SLBE and SELBE firms are for construction, personal and professional services, goods and services, maintenance, repairs, and operations where responsibility and quality are equal. The preference will be 5% of the bid amount of the lowest responsive responsible bidder, and may not exceed \$50,000.00 for any bid.

A Non-SLBE/SELBE Prime Contractor who utilizes 25% of total bid amount, with SLBE or SELBE subcontractors (who meet the District's Definition of an SLBE and SELBE), can also receive a maximum of 4% bidding preference, not to exceed \$50,000.00 for any bid. (See below Subcontractor section.)

Definitions:

SLBE: A Small Local Business Enterprise is a business that has not exceeded gross annual revenue of 8.5 million dollars for a construction firm, or 6 million dollars for goods and non-professional services firm, or 3 million dollars for architecture, engineering and professional services firm, for the past three consecutive years and meets the below geographic location requirements.

SELBE: A Small Local Emerging Business Enterprise is a business that has not exceeded gross annual revenue of 1.5 million dollars for the past three consecutive years and meets the below geographic location requirements.

Commercially Useful Function: Shall mean a business is directly responsible for providing the materials, equipment, supplies or services to the District as required by the contract solicitation. The business performs work that is normal for its business services and carries out its obligation by actually performing, managing, or supervising the work involved. The business is not Commercially Useful if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of SLBE or SELBE participation.

Geographic Location Requirements:

- The business must be located at a fixed, established commercial address located in the District's market area of Albany, Alameda, Berkeley, Emeryville, Oakland, or Piedmont, and not a temporary or movable office, a post office box, or a telephone answering service.
- If the business has an office outside of the District's market area as well as an office within

the market area, the office within the District's market area must be staffed on a full time permanent basis with someone employed by the business.

- If requested, the business that has an office outside of the District's market area must provide proof of one or more past contracts citing the business address (such as contracts to perform work, to rent space or equipment, or for other business services) was within the District's market area at least one (1) year prior to the date of contract award. The one-year requirement does not apply to businesses whose sole establishment is located within the District's market area.

Subcontractors:

Non-SLBE/SELBE Prime Contractors who use subcontractors, who meet the district definitions of SLBE and SELBE, may receive a maximum of 4% bidding preference if the following conditions are met:

1. 25% of total bid amount is with Subcontractors who meet the District's definition of an SLBE and SELBE. The Prime Contractor must list each Subcontractor on the Subcontractor List form, clearly identifying the SLBE and SELBE status and the Dollar Amount of work each subcontractor will perform.
2. The Subcontractors must provide a Commercially Useful Function.
3. The Prime Contractor must maintain the Subcontractor percentages (based on the quoted dollar amounts) indicated in the Subcontractor List form at the time the Contract is awarded and throughout the term of the Contract.
4. The Prime Contractor must fill out sign the SLBE/SELBE Self Certification Affidavit and return it with the bid documents, and 48 hours after the bid opening the Prime Contractor must submit signed SLBE/SELBE Self Certification Affidavit from each of the SLBE and SELBE subcontractors listed in the Subcontractor form. The Subcontractor must agree to provide the requested documentation to verify the SLBE/SEBLE status.
5. No Substitutions can be made to the SLBE and SELBE subcontractor without the prior written approval of the District. The District will approve a subcontractor substitution on the following conditions:
 - a. A written statement from the subcontractor agreeing to the substitution.
 - b. When the subcontractor has been given a reasonable opportunity to execute the subcontract, yet fails to, or refuses to execute the subcontract, or refuses to satisfy contractual obligations.
 - c. When the subcontractor becomes insolvent.
 - d. When the District determines the work performed by the subcontractor is not in accordance with the contact agreement, or the subcontractor is substantially and unduly delaying or disrupting the progress of work.

Firms that meet the District criteria for an SLBE and SELBE can complete the below self-certification affidavit signed under penalty of perjury. Firms claiming SLBE and SELBE status in the self-certification affidavit will be required to submit proof of residency and revenue 48 hours after bid opening. Such proof shall consist of a copy of a contract to perform work, to rent space or equipment, or for other business services, executed from their local address, and the firm's tax returns for the past three consecutive years.



Peralta Community College District

SLBE/SELBE SELF CERTIFICATION AFFIDAVIT

I certify under penalty of perjury that my firm meets the District’s definition of a Small Local Business Enterprise or a Small Emerging Local Business Enterprise and resides in the geographic location of the District’s market area and qualifies for the below preference. The maximum preference will be five percent of the bid amount of the lowest responsible bidder, and may not exceed \$50,000.00 for any bid. The preference is only used for computation purposes to determine the winning bidder; the contract is awarded at the actual bid amount. The District’s Contract Compliance Office will determine whether this requirement has been fulfilled. Bidders may only claim one of the below preferences.

Certification Status	Preference	Preference Claimed (check only one)
SLBE	5% of lowest bid	
SELBE	5% of lowest bid	
25% of Subcontractors are SLBE/SELBE	4% of lowest bid	
Not a SLBE/SELBE	None	

1. I acknowledge and am hereby advised that upon a finding of perjury with the claims made in this self certification affidavit the District is authorized to impose penalties which may include any of the following:
 - a) Refusal to certify the award of a contract
 - b) Suspension of a contract
 - c) Withholding of funds
 - d) Revision of a contract for material breach of contract
 - e) Disqualification of my firm from eligibility for providing goods and services to the Peralta Community College District for a period not to exceed five (5) years

2. I acknowledge and have been advised and hereby agree that my firm will be required to provide proof (and if applicable, my SLBE and SELBE Subcontractors will provide proof) of the status claimed on this self-certification affidavit 48 hours after bid opening. Proof of status claimed includes tax returns from the previous three years and past contracts to determine the size and geographical location of my firm.

3. I declare that the above provisions are attested to under penalty of perjury under the laws of the State of California.

Bid Number: _____ Bid Name: _____

Signed Date

Printed or typed name Title

Name of Company Telephone Fax



Peralta Community College District

VENDOR'S QUESTIONNAIRE AND CERTIFICATE BY COMPLIANCE

The following information is requested for information purposes only. It will not be used in determining bid award.

Date _____

Firm Name _____ Telephone _____

Business Fax _____ Email Address _____ Website _____

Street Address _____ City/State _____ Zip Code+ 4® _____

Mailing Address _____ City/State _____ Zip Code + 4® _____

Type of Organization (Check one) Individual Partnership Corporation

Name of Owner(s) _____ State of Incorporation (if applicable) _____

Name of Partners _____ (I) Indicate (G) General (L) Limited _____

Local Address _____

Amount of Annual Business _____

The District is identifying vendor ownership as follows:

	Asian-American (Chinese, Japanese, Korean, Vietnamese)	Black or African- American	Hawaiian	Latino (other than Mexican or Mexican- American)	Mexican or Mexican- American	Native – American	Pacific Islander, other Asian	White	Disabled	Veteran	Women	Subcontractor	Employee	Apprentice
Total #														
% of assets														

The District is identifying vendor workforce as follows:

	Asian- American (Chinese, Japanese, Korean, Vietnamese)	Black or African- American	Hawaiian	Latino (other than Mexican or Mexican- American)	Mexican or Mexican- American	Native – American	Pacific Islander, other Asian	White	Disabled	Veteran	Women	Subcontractor	Employee	Apprentice
Total #														
% of assets														

Explain whether current workforce is racially and ethnically proportionate to the area from which the workforce is drawn (national, state, or local). Use separate sheet if necessary.

--

Detail steps taken by vendor since inception to assure non-discriminatory recruiting, hiring, and apprenticeship, placement, promotion, demotion, layoff and termination practices. Use separate sheet if necessary.

--

What are you interested in providing the District? (e.g., construction, consulting, goods or services).

--

Main Headquarters Office(s) Address/Telephone (List all as applicable)	1. 2. 3.
--	------------------------

Total # of Employees _____

Local Office(s) Address/Telephone (List all as applicable)	1. 2. 3.
--	------------------------

Total # of Employees _____

Name and list residential zip code for each employee, subcontractor, or apprentice for awarded contract (Please use the Zip+4®) Use separate sheet as necessary	1. 2. 3. 4. 5. 6.
--	----------------------------------

DOCUMENT 00 45 49

REGISTERED SUBCONTRACTORS LIST
(Labor Code Section 1771.1)

PROJECT: MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)_____

Date Submitted (for Updates): _____

Contractor acknowledges and agrees that it must clearly set forth below the name and Department of Industrial Relations (DIR) registration number of each subcontractor **for all tiers** who will perform work or labor or render service to Contractor or its subcontractors in or about the construction of the Work **at least two (2) weeks before the subcontractor is scheduled to perform work**. This document is to be updated as all tiers of subcontractors are identified.

Contractor acknowledges and agrees that, if Contractor fails to list as to any subcontractor of any tier who performs any portion of Work, the Contract is subject to cancellation and the Contractor will be subjected to penalty under applicable law.

If further space is required for the list of proposed subcontractors, attach additional copies of page 2 showing the required information, as indicated below.

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Subcontractor Name: _____

DIR Registration #: _____

Portion of Work: _____

Date: _____

Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 45 90

POST BID INTERVIEW

PART 1 – GENERAL**1.01 SUMMARY**

If requested by the District, this Section requires the apparent low bidder to attend and participate in a Post Bid Interview with the Construction Manager, prior to award of any contract by the District. The Post Bid Interview will be scheduled by the Construction Manager within three (3) calendar days after the date of bid.

1.02 REQUIRED ATTENDANCE

- A. A duly authorized representative of the apparent low bidder is required to attend the Post Bid Interview, in person.
- B. The apparent low bidder's authorized representative(s) must have (1) knowledge of how the bid submitted was prepared, (2) the person responsible for supervising performance of the Work, and (3) the authority to bind the apparent low bidder.
- C. Failure to attend the Post Bid Interview as scheduled will be considered just cause for the District to reject the Bid as nonresponsive.

1.03 POST BID INTERVIEW PROCEDURE

- A. The Construction Manager will review the Bid with the attendees.
- B. The Construction Manager will review the Contract Documents with the attendees, including but not limited to:
 - (1) Insurance
 - (2) Bonding
 - (3) Addenda
 - (4) Pre-Bid Clarifications
 - (5) Scope of Work
 - (6) Bid Packages Descriptions
 - (7) Bid Alternates
 - (8) Contract Plans
 - (9) Contract Specifications
 - (10) Project Schedule and Schedule Requirements

- (11) Critical Dates Requirement for Other Bid Packages
- (12) Prevailing Wage Requirements
- (13) Liquidated Damages
- (14) Required Documentation for Contract Administration
- (15) Contract Coordination Requirements

1.04 POST BID INTERVIEW DOCUMENTATION

The Construction Manager will document the Post Bid Interview on the form attached to this Section. Both the apparent low bidder and the Construction Manager are required to sign the Post Bid Interview Documentation.

POST BID INTERVIEW

CONSTRUCTION MANAGER

[Name]

[Address 1]

[Address 2]

[Phone]

[Fax]

BIDDER: _____

DATE: _____ TIME: _____ PHONE: _____

I. INTRODUCTIONS:

A. Present

CONTRACTOR

[CM]

CONTRACTOR

[CM]

II. PROPOSED CONTRACT:

III. PURPOSE OF INTERVIEW IS TO ASSURE A MUTUAL UNDERSTANDING OF THE FOLLOWING:

- A. Do you acknowledge submission of a complete and accurate bid? Yes No
- B. Do you acknowledge the Bid Document submittal timelines after NOA and NTP and can you meet those timelines? Yes No
- C. Do you acknowledge the requirements for the escrow of bid documents? Yes No
- D. Are you comfortable with your listed subcontractors? Yes No

IV. CONTRACTUAL REQUIREMENTS:

- A. Do you understand you are a prime contractor? Yes No
- B. Can you meet specified insurance requirements? Yes No
 - 1. Do any of your policies that require Additional Insured endorsements exceed the minimum coverage requirements? Yes No
 - 2. Are you requesting that the District accept an Umbrella or Excess Liability Insurance Policy to meet the policy limit? Yes No

- 3. Will there be a gap between the per occurrence amount of any underlying policy and the start of the coverage under the Umbrella or Excess Liability Insurance Policy? Yes No

- C. Will you provide the Performance Bond and Labor and Material Bond for 100% of the Contract Price as stipulated? Yes No
 - 1. Cost for bond: _____% Yes No
 - 2. Is the cost of your bond in your base bid? Yes No
 - 3. Is your surety licensed to issue bonds in California? Yes No

- D. Do you understand the sex offender registration requirements? Yes No

- E. Is it understood that all workers must be paid prevailing wage? Yes No

- F. Is it understood that all subcontractors of every tier must be registered as a public works contractor with the Department of Industrial Relations? Yes No

- V. SCOPE OF WORK:

- A. Acknowledged Receipt of Addenda #1-___ Yes No

- B. Are the costs for addenda items included in your bid? (if applicable) Yes No

- C. Do you have a complete understanding of your Scope of Work under the proposed Agreement? Yes No

- D. You have re-reviewed the documents and understand the Scope of the Work. Are there any items that require clarification? Yes No

If yes, please identify them.

- 1. _____

- 2. _____

- 3. _____

Is (are) there additional cost(s) for the above item(s)? Yes No

- E. Have you reviewed bid alternative(s) #1-___? (If applicable) Yes No
- F. Are the costs for bid alternatives included in your bid? Yes No
- G. Are the plans and specifications clear and understandable to your satisfaction? Yes No
- H. Do you acknowledge that the time to submit notice of requests for substitution of specified materials has expired? Yes No

VI. SCHEDULE:

- A. Do you acknowledge and agree to the stipulated completion dates and milestones in the contract? Yes No
 - 1. Will you provide a detailed construction schedule to _____ within the required ten (10) days of the Notice to Proceed, per the contract? Yes No
 - 2. Can you meet the submittal deadline? Yes No
 - 3. It is understood that the Project schedule is critical and that that weekend and overtime work may be required to meet the milestones. Yes No
 - 4. It is understood that if rain does occur, then all dewatering and protection of work is required, per the contract. Yes No
If not, what do you believe must change and why? _____

- B. Identify critical materials, deliveries, long lead items and other dependencies, including Owner Furnished items that could affect the completion of your work. Yes No

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

C. Do you understand that there is going to be maintenance and other construction taking place on site during the course of the project? Yes No

VII. EXECUTION OF WORK

A. Do you understand the access to the site? Yes No

B. Do you understand the staging area restrictions? Yes No

C. Have you included protection of [asphalt, floors, and roofs]? Yes No

D. Do you understand that the site is occupied by students, teachers, administrators, parents, etc.? Yes No

VIII. CONTRACTOR COMMENTS/SUGGESTIONS:

- 1. _____
2. _____
3. _____
4. _____
5. _____

IX. CONTRACTOR

You agree the information contained herein is part of your contractual obligations. Your signature acknowledges your agreement to perform all Work in the Contract Documents, and that costs for all Work are included in your bid.

The foregoing information is true and accurate, and I am authorized to sign as an officer of the company I am representing.

[Company Name]

Signature _____ Title: _____

Date: _____

X. CONSTRUCTION MANAGER

Signature _____ Title: _____

Date: _____

Title of Document: POST BID INTERVIEW

Number of Pages: _____

Date of Document: _____

END OF DOCUMENT

DOCUMENT 00 51 00

NOTICE OF AWARD

Dated: _____ 20__

To: _____ (Contractor)

To: _____
(Address)

From: Governing Board ("Board") of the Peralta Community College District ("District")

RE: MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)/ _____ ,
Project No. 2425 ("Project").

Contractor has been awarded the Contract for the above referenced Project on
, 20__, by action of the District's Board.

The Contract Price is Dollars _____ (\$
) , and includes alternates.

Three (3) copies of each of the Contract Documents (except Drawings) accompany this Notice of Award. Three (3) sets of the Drawings will be delivered separately or otherwise made available. Additional copies are available at cost of reproduction.

You must comply with the following conditions precedent within **SEVEN (7)** calendar days of the date of this Notice of Award.

The Contractor shall execute and submit the following documents by 5:00 p.m. of the **SEVENTH (7th)** calendar day following the date of the Notice of Award.

- a. Agreement: To be executed by successful Bidder. Submit three (3) copies, each bearing an original signature.
- b. Escrow of Bid Documentation: This must include all required documentation. See document titled Escrow Bid Documentation for more information.
- c. Performance Bond (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
- d. Payment Bond (Contractor's Labor & Material Bond) (100%): On the form provided in the Contract Documents and fully executed as indicated on the form.
- e. Insurance Certificates and Endorsements as required.
- f. Workers' Compensation Certification.
- g. Prevailing Wage and Related Labor Requirements Certification.
- h. Drug-Free Workplace Certification.

- i. Tobacco-Free Environment Certification.
- j. Hazardous Materials Certification.
- k. Lead-Based Materials Certification.
- l. Imported Materials Certification.
- m. Sex Offender Registration Act Certification.
- n. Buy American Certification.
- o. SLBE/SELBE Self Certification Affidavit.
- p. Registered Subcontractors List: Must include Department of Industrial Relations (DIR) registration number of each subcontractor for all tiers.

Failure to comply with these conditions within the time specified will entitle District to consider your bid abandoned, to annul this Notice of Award, and to declare your Bid Security forfeited, as well as any other rights the District may have against the Contractor.

After you comply with those conditions, District will return to you one fully signed counterpart of the Agreement.

PERALTA COMMUNITY COLLEGE DISTRICT

BY: _____

NAME: _____

TITLE: _____

END OF DOCUMENT

DOCUMENT 00 52 13

AGREEMENT

THIS AGREEMENT IS MADE AND ENTERED INTO THIS _____ DAY OF _____
 _____, 20____, by and between the Peralta Community College District ("District") and _____
 _____ ("Contractor")
 ("Agreement").

WITNESSETH: That the parties hereto have mutually covenanted and agreed, and by these presents do covenant and agree with each other, as follows:

- 1. The Work:** Contractor agrees to furnish all tools, equipment, apparatus, facilities, labor, and material necessary to perform and complete in a good and workmanlike manner, the work of the following project:

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC) ("Project" or "Contract" or "Work")

It is understood and agreed that the Work shall be performed and completed as required in the Contract Documents including, without limitation, the Drawings and Specifications and submission of all documents required to secure funding or by the Division of the State Architect for close-out of the Project, under the direction and supervision of, and subject to the approval of, the District or its authorized representative.

- 2. The Contract Documents:** The complete Contract consists of all Contract Documents as defined in the General Conditions and incorporated herein by this reference. Any and all obligations of the District and Contractor are fully set forth and described in the Contract Documents. All Contract Documents are intended to cooperate so that any Work called for in one and not mentioned in the other or vice versa is to be executed the same as if mentioned in all Contract Documents.
- 3. Interpretation of Contract Documents:** Should any question arise concerning the intent or meaning of Contract Documents, including the Drawings or Specifications, the question shall be submitted to the District for interpretation. If a conflict exists in the Contract Documents, valid, written modifications, beginning with the most recent, shall control over this Agreement (if any), which shall control over the Special Conditions, which shall control over any Supplemental Conditions, which shall control over the General Conditions, which shall control over the remaining Division 0 documents, which shall control over Division 1 Documents which shall control over Division 2 through Division 49 documents, which shall control over figured dimensions, which shall control over large-scale drawings, which shall control over small-scale drawings. In the case of a discrepancy or ambiguity solely between and among the Drawings and Specifications, the discrepancy or ambiguity shall be resolved in favor of the interpretation that will provide District with the functionally complete and operable Project described in the Drawings and Specifications. In no case shall a document calling for lower quality and/or quantity material or workmanship control. The decision of the District in the matter shall be final.

4. **Time for Completion:** It is hereby understood and agreed that the Work under this Contract shall be completed within **540 consecutive calendar days** ("Contract Time") from the date specified in the District's Notice to Proceed.
5. **Completion - Extension of Time:** Should the Contractor fail to complete this Contract, and the Work provided herein, within the time fixed for completion, due allowance being made for the contingencies provided for herein, the Contractor shall become liable to the District for all loss and damage that the District may suffer on account thereof. The Contractor shall coordinate its Work with the Work of all other contractors. The District shall not be liable for delays resulting from Contractor's failure to coordinate its Work with other contractors in a manner that will allow timely completion of Contractor's Work. Contractor shall be liable for delays to other contractors caused by Contractor's failure to coordinate its Work with the Work of other contractors.
6. **Liquidated Damages:** Time is of the essence for all work under this Agreement. It is hereby understood and agreed that it is and will be difficult and/or impossible to ascertain and determine the actual damage that the District will sustain in the event of and by reason of Contractor's delay; therefore, Contractor agrees that it shall pay to the District the sum of **two thousand five hundred dollars (\$2,500.00) per day as liquidated damages for each and every day's delay beyond the time herein prescribed in the finishing of each Milestone as identified in Specification Section 01 32 12 Scheduling of Work.**

It is hereby understood and agreed that this amount is not a penalty.

In the event that any portion of the liquidated damages is not paid to the District, the District may deduct that amount from any money due or that may become due the Contractor under this Agreement, and such deduction does not constitute a withholding or penalty. The District's right to assess liquidated damages is as indicated herein and in the General Conditions.

The time during which the Contract is delayed for cause, as hereinafter specified, may extend the time of completion for a reasonable time as the District may grant, provided that Contractor has complied with the claims procedure of the Contract Documents. This provision does not exclude the recovery of damages by either party under other provisions in the Contract Documents.

7. **Loss Or Damage:** The District and its agents and authorized representatives shall not in any way or manner be answerable or suffer loss, damage, expense, or liability for any loss or damage that may happen to the Work, or any part thereof, or in or about the same during its construction and before acceptance, and the Contractor shall assume all liabilities of every kind or nature arising from the Work, either by accident, negligence, theft, vandalism, or any cause whatsoever; and shall hold the District and its agents and authorized representatives harmless from all liability of every kind and nature arising from accident, negligence, or any cause whatsoever.
8. **Limitation Of District Liability:** District's financial obligations under this Contract shall be limited to the payment of the compensation provided in this Contract. Notwithstanding any other provision of this Contract, in no event shall District be liable, regardless of whether any claim is based on contract or tort, for any special, consequential, indirect or incidental damages, including, but not limited to, lost

profits or revenue, lost bonding capacity, arising out of or in connection with this Contract for the services performed in connection with this Contract.

9. **Insurance and Bonds:** Prior to issuance of the Notice to Proceed by the District, Contractor shall provide all required certificates of insurance, insurance endorsements, and payment and performance bonds as evidence thereof.
10. **Prosecution of Work:** If the Contractor should neglect to prosecute the Work properly or fail to perform any provisions of this Contract, the District, may, pursuant to the General Conditions and without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor.
11. **Authority of Architect, Project Inspector, and DSA:** Contractor hereby acknowledges that the Architect(s), the Project Inspector(s), and the Division of the State Architect ("DSA") have authority to approve and/or suspend Work if the Contractor's Work does not comply with the requirements of the Contract Documents, Title 24 of the California Code of Regulations, and all applicable laws and regulations. The Contractor shall be liable for any delay caused by its non-compliant Work.
12. **Assignment of Contract:** Neither the Contract, nor any part thereof, nor any moneys due or to become due thereunder, may be assigned by the Contractor without the prior written approval of the District, nor without the written consent of the Surety on the Contractor's Performance Bond (the "Surety"), unless the Surety has waived in writing its right to notice of assignment.
13. **Classification of Contractor's License:** Contractor hereby acknowledges that it currently holds valid Type B – General Contractor's license(s) issued by the State of California, Contractors' State License Board, in accordance with division 3, chapter 9, of the Business and Professions Code and in the classification called for in the Contract Documents.
14. **Registration as Public Works Contractor:** The Contractor and all Subcontractors currently are registered as public works contractors with the Department of Industrial Relations, State of California, in accordance with Labor Code section 1771.1.
15. **Payment of Prevailing Wages:** The Contractor and all Subcontractors shall pay all workers on all Work performed pursuant to this Contract not less than the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work as determined by the Director of the Department of Industrial Relations, State of California, for the type of work performed and the locality in which the work is to be performed within the boundaries of the District, pursuant to sections 1770 et seq. of the California Labor Code.
16. This Project is subject to labor compliance monitoring and enforcement by the Department of Industrial Relations pursuant to Labor Code section 1771.4 and Title 8 of the California Code of Regulations. Contractor specifically acknowledges and understands that it shall perform the Work of this Agreement while complying with all the applicable provisions of Division 2, Part 7, Chapter 1, of the Labor Code, including, without limitation, the requirement that the Contractor and all of its

Subcontractors shall timely submit complete and accurate electronic certified payroll records as required by the Contract Documents, or the District may not issue payment.

- 17. Contract Price:** In consideration of the foregoing covenants, promises, and agreements on the part of the Contractor, and the strict and literal fulfillment of each and every covenant, promise, and agreement, and as compensation agreed upon for the Work and construction, erection, and completion as aforesaid, the District covenants, promises, and agrees that it will well and truly pay and cause to be paid to the Contractor in full, and as the full Contract Price and compensation for construction, erection, and completion of the Work hereinabove agreed to be performed by the Contractor, the following price:

_____ Dollars

(\$ _____),

in lawful money of the United States, which sum is to be paid according to the schedule provided by the Contractor and accepted by the District and subject to additions and deductions as provided in the Contract. This amount supersedes any previously stated and/or agreed to amount(s).

- 18. No Representations:** No representations have been made other than as set forth in writing in the Contract Documents, including this Agreement. Each of the Parties to this Agreement warrants that it has carefully read and understood the terms and conditions of this Agreement and all Contract Documents, and that it has not relied upon the representations or advice of any other Party or any attorney not its own.
- 19. Entire Agreement:** The Contract Documents, including this Agreement, set forth the entire agreement between the parties hereto and fully supersede any and all prior agreements, understandings, written or oral, between the parties hereto pertaining to the subject matter thereof.
- 20. Severability:** If any term, covenant, condition, or provision in any of the Contract Documents is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remainder of the provisions in the Contract Documents shall remain in full force and effect and shall in no way be affected, impaired, or invalidated thereby.

IN WITNESS WHEREOF, accepted and agreed on the date indicated above:

CONTRACTOR

PERALTA COMMUNITY COLLEGE DISTRICT

By: _____

By: _____

Title: _____

Title: _____

NOTE: If the party executing this Contract is a corporation, a certified copy of the by-laws, or of the resolution of the Board of Directors, authorizing the officers of said

corporation to execute the Contract and the bonds required thereby must be attached hereto.

DOCUMENT 00 55 00

NOTICE TO PROCEED

Dated: _____, 20__

TO: _____
("Contractor")

ADDRESS: _____

PROJECT: MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)

PROJECT NO. 2425:
between the Peralta Community College District and Contractor ("Contract").

You are notified that the Contract Time under the above Contract will commence to run on _____, 20___. By that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement executed by Contractor, the date of completion is _____, 20___.

You must submit the following documents by 5:00 p.m. of the TENTH (10th) calendar day following the date of this Notice to Proceed:

- a. Contractor's preliminary schedule of construction.
- b. Contractor's preliminary schedule of values for all of the Work.
- c. Contractor's preliminary schedule of submittals, including Shop Drawings, Product Data, and Samples submittals
- d. Contractor's Safety Plan specifically adapted for the Project.
- e. Registered Subcontractors List: A complete subcontractors list for all tiers, including the name, address, telephone number, email address, facsimile number, California State Contractors License number, license classification, Department of Industrial Relations registration number, and monetary value of all Subcontracts.

Thank you. We look forward to a very successful Project.

PERALTA COMMUNITY COLLEGE DISTRICT

BY: _____

NAME: _____

TITLE: _____

END OF DOCUMENT

DOCUMENT 00 56 00

ESCROW BID DOCUMENTATION**1. Requirement to Escrow Bid Documentation**

- a. Contractor shall submit, within **SEVEN (7)** calendar days after the date of the Notice of Award, one copy of all documentary information received or generated by Contractor in preparation of bid prices for this Contract, as specified herein. This material is referred to herein as "Escrow Bid Documentation." The Escrow Bid Documentation of the Contractor will be held in escrow for the duration of the Contract.
- b. Contractor agrees, as a condition of award of the Contract, that the Escrow Bid Documentation constitutes all written information used in the preparation of its bid, and that no other written bid preparation information shall be considered in resolving disputes or claims. Contractor also agrees that nothing in the Escrow Bid Documentation shall change or modify the terms or conditions of the Contract Documents.
- c. The Escrow Bid Documentation will not be opened by District except as indicated herein. The Escrow Bid Documentation will be used only for the resolution of change orders and claims disputes.
- d. Contractor's submission of the Escrow Bid Documentation, as with the bonds and insurance documents required, is considered an essential part of the Contract award. Should the Contractor fail to make the submission within the allowed time specified above, District may deem the Contractor to have failed to enter into the Contract, and the Contractor shall forfeit the amount of its bid security, accompanying the Contractor's bid, and District may award the Contract to the next lowest responsive responsible bidder.
- e. NO PAYMENTS WILL BE MADE, NOR WILL DISTRICT ACCEPT PROPOSED CHANGE ORDERS UNTIL THE ABOVE REQUIRED INFORMATION IS SUBMITTED AND APPROVED.
- f. The Escrow Bid Documentation shall be submitted in person by an authorized representative of the Contractor to the District.

2. Ownership of Escrow Bid Documentation

- a. The Escrow Bid Documentation is, and shall always remain, the property of Contractor, subject to review by District, as provided herein.
- b. Escrow Bid Documentation constitute trade secrets, not known outside Contractor's business, known only to a limited extent and only by a limited number of employees of Contractor, safeguarded while in Contractor's possession, extremely valuable to Contractor, and could be extremely valuable to Contractor's competitors by virtue of it reflecting Contractor's contemplated techniques of construction. Subject to the provisions herein, District agrees to safeguard the Escrow Bid Documentation, and all

information contained therein, against disclosure to the fullest extent permitted by law.

3. **Format and Contents of Escrow Bid Documentation**

- a. Contractor may submit Escrow Bid Documentation in its usual cost-estimating format; a standard format is not required. The Escrow Bid Documentation shall be submitted in the language (e.g., English) of the specification.
- b. Escrow Bid Documentation must clearly itemize the estimated costs of performing the work of each bid item contained in the bid schedule, separating bid items into sub-items as required to present a detailed cost estimate and allow a detailed cost review. The Escrow Bid Documentation shall include all subcontractor bids or quotes, supplier bids or quotes, quantity takeoffs, crews, equipment, calculations of rates of production and progress, copies of quotes from subcontractors and suppliers, and memoranda, narratives, add/deduct sheets, and all other information used by the Contractor to arrive at the prices contained in the bid proposal. Estimated costs should be broken down into Contractor's usual estimate categories such as direct labor, repair labor, equipment ownership and operation, expendable materials, permanent materials, and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the Contractor's usual format. The Contractor's allocation of indirect costs, contingencies, markup, and other items to each bid item shall be identified.
- c. All costs shall be identified. For bid items amounting to less than \$10,000, estimated unit costs are acceptable without a detailed cost estimate, provided that labor, equipment, materials, and subcontracts, as applicable, are included and provided that indirect costs, contingencies, and markup, as applicable, are allocated.
- d. Bid Documentation provided by District should not be included in the Escrow Bid Documentation unless needed to comply with the following requirements.

4. **Submittal of Escrow Bid Documentation**

- a. The Escrow Bid Documentation shall be submitted by the Contractor in a sealed container within **SEVEN (7)** calendar days after the date of the Notice of Award. The container shall be clearly marked on the outside with the Contractor's name, date of submittal, project name and the words "Escrow Bid Documentation – Intended to be opened in the presence of Authorized Representatives of Both District and Contractor".
- b. By submitting Escrow Bid Documentation, Contractor represents that the material in the Escrow Bid Documentation constitutes all the documentary information used in preparation of the bid and that the Contractor has personally examined the contents of the Escrow Bid Documentation container and has found that the documents in the container are complete.
- c. If Contractor's proposal is based upon subcontracting any part of the work, each subcontractor whose total subcontract price exceeds 5 percent of the total contract price proposed by Contractor, shall provide separate Escrow

Documents to be included with those of Contractor. Those documents shall be opened and examined in the same manner and at the same time as the examination described above for Contractor.

- d. If Contractor wishes to subcontract any portion of the Work after award, District retains the right to require Contractor to submit Escrow Documents for the Subcontractor before the subcontract is approved.

5. Storage, Examination and Final Disposition of Escrow Bid Documentation

- a. The Escrow Bid Documentation will be placed in escrow, for the life of the Contract, in a mutually agreeable institution. The cost of storage will be paid by Contractor for the duration of the project until final Contract payment. The storage facilities shall be the appropriate size for all the Escrow Bid Documentation and located conveniently to both District's and Contractor's offices.
- b. The Escrow Bid Documentation shall be examined by both District and Contractor, at any time deemed necessary by either District or Contractor, to assist in the negotiation of price adjustments and change orders or the settlement of disputes and claims. In the case of legal proceedings, Escrow Bid Documentation shall be used subject to the terms of an appropriate protective order if requested by Contractor and ordered by a court of competent jurisdiction. Examination of the Escrow Bid Documentation is subject to the following conditions:
- (1) As trade secrets, the Escrow Bid Documentation is proprietary and confidential to the extent allowed by law.
 - (2) District and Contractor shall each designate, in writing to the other party **SEVEN (7)** calendar days prior to any examination, the names of representatives who are authorized to examine the Escrow Bid Documentation. No other person shall have access to the Escrow Bid Documentation.
 - (3) Access to the documents may take place only in the presence of duly designated representatives of the District and Contractor. If Contractor fails to designate a representative or appear for joint examination on **SEVEN (7)** calendar days' notice, then the District representative may examine the Escrow Bid Documents alone upon an additional **THREE (3)** calendar days' notice if a representative of the Contractor does not appear at the time set.
 - (4) If a subcontractor has submitted sealed information to be included in the Escrow Bid Documents, access to those documents may take place only in the presence of a duly designated representative of the District, Contractor and that subcontractor. If that subcontractor fails to designate a representative or appear for joint examination on **SEVEN (7)** calendar days' notice, then the District representative and/or the Contractor may examine the Escrow Bid Documentation without that subcontractor present upon an additional **THREE (3)** calendar days'

notice if a representative of that subcontractor does not appear at the time set.

- c. The Escrow Bid Documentation will be returned to Contractor at such time as the Contract has been completed and final settlement has been achieved.

END OF DOCUMENT

DOCUMENT 00 57 00

ESCROW AGREEMENT IN LIEU OF RETENTION
(Public Contract Code Section 22300)

(Note: Contractor must use this form.)

This Escrow Agreement in Lieu of Retention ("Escrow Agreement") is made and entered into this _____ day of _____, 20____, by and between the Peralta Community College District ("District"), whose address is 333 East 8th Street, Oakland, California 94606, and _____ ("Contractor"), whose address is _____, and _____ ("Escrow Agent"), a state or federally chartered bank in the state of California, whose address is _____.

For the consideration hereinafter set forth, District, Contractor, and Escrow Agent agree as follows:

1. Pursuant to section 22300 of Public Contract Code of the State of California, which is hereby incorporated by reference, Contractor has the following two (2) options:
 - Deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by District pursuant to the Construction Contract No. _____ entered into between District and Contractor for the _____ Project, in the amount of _____ Dollars (\$ _____) dated, _____, 20____, (the "Contract"); **or**
 - On written request of Contractor, District shall make payments of the retention earnings for the above referenced Contract directly to Escrow Agent.

When Contractor deposits the securities as a substitute for Contract earnings (first option), Escrow Agent shall notify District within ten (10) calendar days of the deposit. The market value of the securities at the time of substitution and at all times from substitution until the termination of the Escrow Agreement shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract between District and Contractor.

Securities shall be held in name of Peralta Community College School District, and shall designate Contractor as beneficial owner.

2. District shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to Contract provisions, provided that Escrow Agent holds securities in form and amount specified above.
3. When District makes payment of retention earned directly to Escrow Agent, Escrow Agent shall hold them for the benefit of Contractor until the time that the escrow created under this Escrow Agreement is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Escrow

Agreement and the rights and responsibilities of the Parties shall be equally applicable and binding when District pays Escrow Agent directly.

4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account, and all expenses of District. The District will charge Contractor \$_____ for each of District's deposits to the escrow account. These expenses and payment terms shall be determined by District, Contractor, and Escrow Agent.
5. Interest earned on securities or money market accounts held in escrow and all interest earned on that interest shall be for sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to District.
6. Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from District to Escrow Agent that District consents to withdrawal of amount sought to be withdrawn by Contractor.
7. District shall have the right to draw upon the securities and/or withdraw amounts from the Escrow Account in the event of default by Contractor. Upon seven (7) days' written notice to Escrow Agent from District of the default, if applicable, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by District. Escrow Agent shall not be authorized to determine the validity of any notice of default given by District pursuant to this paragraph, and shall promptly comply with District's instructions to pay over said escrowed assets. Escrow Agent further agrees to not interplead the escrowed assets in response to a conflicting demand.
8. Upon receipt of written notification from District certifying that the Contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all monies and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on written notifications from District and Contractor pursuant to Paragraphs 5 through 8, inclusive, of this Escrow Agreement and District and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of securities and interest as set forth above.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

10. Names of persons who are authorized to give written notice or to receive written notice on behalf of District and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

On behalf of District:

On behalf of Contractor:

Title

Title

Name

Name

Signature

Signature

Address

Address

On behalf of Escrow Agent:

Title

Name

Signature

Address

At the time that the Escrow Account is opened, District and Contractor shall deliver to Escrow Agent a fully executed copy of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement by their proper officers on the date first set forth above.

On behalf of District:

On behalf of Contractor:

Title

Title

Name

Name

Signature

Signature

Address

Address

END OF DOCUMENT

DOCUMENT 00 61 13.13

PERFORMANCE BOND
(100% of Contract Price)

(Note: Contractor must use this form, NOT a surety company form.)

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the governing board ("Board") of the Peralta Community College District ("District") and _____ ("Principal") have entered into a contract for the furnishing of all materials and labor, services and transportation, necessary, convenient, and proper to perform the following project: MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC) _____ ("Project" or "Contract") which Contract dated , 20____, and all of the Contract Documents attached to or forming a part of the Contract, are hereby referred to and made a part hereof; and

WHEREAS, said Principal is required under the terms of the Contract to furnish a bond for the faithful performance of the Contract.

NOW, THEREFORE, the Principal and _____ ("Surety") are held and firmly bound unto the Board of the District in the penal sum of _____ Dollars (\$_____), lawful money of the United States, for the payment of which sum well and truly to be made we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally, firmly by these presents, to:

- Promptly perform all the work required to complete the Project; and
- Pay to the District all damages the District incurs as a result of the Principal's failure to perform all the Work required to complete the Project.

Or, at the District's sole discretion and election, the Surety shall obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by the District of the lowest responsible bidder, arrange for a contract between such bidder and the District and make available as Work progresses sufficient funds to pay the cost of completion less the "balance of the Contract Price," and to pay and perform all obligations of Principals under the Contract, including, without limitation, all obligations with respect to warranties, guarantees and the payment of liquidated damages. The term "balance of the Contract Price," as used in this paragraph, shall mean the total amount payable to Principal by the District under the Contract and any modifications thereto, less the amount previously paid by the District to the Principal, less any withholdings by the District allowed under the Contract. District shall not be required or obligated to accept a tender of a completion contractor from the Surety for any or no reason.

The condition of the obligation is such that, if the above bound Principal, its heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in the Contract and any alteration thereof made as therein provided, on its part to be kept and performed at the time and in the intent and meaning, including all contractual guarantees and warranties of materials and workmanship, and shall indemnify and save harmless the

District, its trustees, officers and agents, as therein stipulated, then this obligation shall become null and void, otherwise it shall be and remain in full force and virtue.

Surety expressly agrees that the District may reject any contractor or subcontractor proposed by Surety to fulfill its obligations in the event of default by the Principal. Surety shall not utilize Principal in completing the Work nor shall Surety accept a Bid from Principal for completion of the Work if the District declares the Principal to be in default and notifies Surety of the District's objection to Principal's further participation in the completion of the Work.

As a condition precedent to the satisfactory completion of the Contract, the above obligation shall hold good for a period equal to the warranty and/or guarantee period of the Contract, during which time Surety's obligation shall continue if Contractor shall fail to make full, complete, and satisfactory repair and replacements and totally protect the District from loss or damage resulting from or caused by defective materials or faulty workmanship. The obligations of Surety hereunder shall continue so long as any obligation of Contractor remains. Nothing herein shall limit the District's rights or the Contractor or Surety's obligations under the Contract, law or equity, including, but not limited to, California Code of Civil Procedure section 337.15.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond. The Surety also stipulates and agrees that it shall not be exonerated or released from the obligation of this bond by any overpayment or underpayment by the District that is based upon estimates approved by the Architect. The Surety does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract or to the work or to the specifications.

IN WITNESS WHEREOF, two (2) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety above named, on the _____ day of _____, 20____.

Principal	Surety
By	By
	Name of California Agent of Surety
	Address of California Agent of Surety
	Telephone No. of California Agent of Surety

Contractor must attach a Notarial Acknowledgment for all Surety's signatures and a Power of Attorney and Certificate of Authority for Surety. The California Department of Insurance must authorize the Surety to be an admitted surety insurer.

END OF DOCUMENT

DOCUMENT 00 61 13.16

PAYMENT BOND
Contractor's Labor & Material Bond
(100% Of Contract Price)

(Note: Contractor must use this form, NOT a surety company form.)

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the governing board ("Board") of the Peralta Community College District, ("District") and _____, ("Principal") have entered into a contract for the furnishing of all materials and labor, services and transportation, necessary, convenient, and proper to perform the following project:

MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC) which Contract dated _____, 20____, and all of the Contract Documents attached to or forming a part of the Contract, are hereby referred to and made a part hereof; and

WHEREAS, pursuant to law and the Contract, the Principal is required, before entering upon the performance of the work, to file a good and sufficient bond with the body by which the Contract is awarded in an amount equal to one hundred percent (100%) of the Contract price, to secure the claims to which reference is made in sections 9000 through 9510 and 9550 through 9566 of the Civil Code, and division 2, part 7, of the Labor Code.

NOW, THEREFORE, the Principal and _____ ("Surety") are held and firmly bound unto all laborers, material men, and other persons referred to in said statutes in the sum of _____ Dollars (\$_____), lawful money of the United States, being a sum not less than the total amount payable by the terms of Contract, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns, jointly and severally, by these presents.

The condition of this obligation is that if the Principal or any of its subcontractors, or the heirs, executors, administrators, successors, or assigns of any, all, or either of them shall fail to pay for any labor, materials, provisions, or other supplies, used in, upon, for or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or for amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Principal or any of its subcontractors of any tier under Section 13020 of the Unemployment Insurance Code with respect to such work or labor, that the Surety will pay the same in an amount not exceeding the amount herein above set forth, and also in case suit is brought upon this bond, will pay a reasonable attorney's fee to be awarded and fixed by the court, and to be taxed as costs and to be included in the judgment therein rendered.

It is hereby expressly stipulated and agreed that this bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under section 9100 of the Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Should the condition of this bond be fully performed, then this obligation shall become null and void; otherwise it shall be and remain in full force and affect.

And the Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of Contract or the specifications accompanying the same shall in any manner affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration, or addition.

IN WITNESS WHEREOF, two (2) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety above named, on the _____ day of _____, 20__.

Principal	Surety
By	By
	Name of California Agent of Surety
	Address of California Agent of Surety
	Telephone No. of California Agent of Surety

Contractor must attach a Notarial Acknowledgment for all Surety's signatures and a Power of Attorney and Certificate of Authority for Surety. The California Department of Insurance must authorize the Surety to be an admitted surety insurer.

END OF DOCUMENT

DOCUMENT 00 63 40

ALLOWANCE EXPENDITURE DIRECTIVE FORM

Peralta Community College District
333 East 8th Street
Oakland, CA 94606

ALLOWANCE EXPENDITURE DIRECTIVE NO.:

ALLOWANCE EXPENDITURE DIRECTIVE

Project:
Bid No.:

Date:
DSA File No.:
DSA Appl. No.:

The following parties agree to the terms of this Allowance Expenditure Directive ("AED"):

Owner Name, Address, Telephone:

Contractor Name, Address, Telephone:

Reference	Description	Allowance Authorized for Expenditure
Request for AED # Requested by: Performed by: Reason:	[Description of unforeseen item relating to Work] [Requester] [Performer] [Reason]	\$
Request for AED # Requested by: Performed by: Reason:	[Description of unforeseen item relating to Work] [Requester] [Performer] [Reason]	\$
Request for AED # Requested by: Performed by: Reason:	[Description of unforeseen item relating to Work] [Requester] [Performer] [Reason]	\$

Total Contract Allowance Amount:	\$
Amount of Previously Approved Allowance Expenditure Directive(s):	\$

Amount of this Allowance Expenditure Directive:	\$
---	----

The undersigned Contractor approves the foregoing release of allowance for completion of each specified item, and agrees to furnish all labor, materials and services and perform all work necessary to complete any additional work specified for the consideration stated therein ("Work"). Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650, et seq.

This Allowance Expenditure Directive must be signed by an authorized District representative.

It is expressly understood that the authorized allowance expenditure granted herein represent a full accord and satisfaction for any and all cost impacts of the items herein, and Contractor waives any and all further compensation based on the items herein. The value of the extra work or changes expressly includes any and all of the Contractor's costs and expenses, and its subcontractors, both direct and indirect. Any costs, expenses, or damages not included are deemed waived.

Signatures:

<p>DISTRICT:</p> <p>PERALTA _____ DISTRICT</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>	<p>CONTRACTOR:</p> <p>_____</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>
<p>ARCHITECT:</p> <p>_____</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>	<p>PROJECT INSPECTOR:</p> <p>_____</p> <p>Date: _____</p> <p>By: _____ [Print Name and Title here]</p>

END OF DOCUMENT

DOCUMENT 00 63 57

PROPOSED CHANGE ORDER FORM

Peralta Community College District
 333 East 8th Street
 Oakland, CA 94606

PCO NO.:

Project:
Bid No.:
RFI #:

Date:
DSA File No.:
DSA Appl. No.:

Contractor hereby submits for District’s review and evaluation this Proposed Change Order (“PCO”), submitted in accordance with and subject to the terms of the Contract Documents, including Sections 17.7 and 17.8 of the General Conditions. Any spaces left blank below are deemed no change to cost or time.

Contractor understands and acknowledges that documentation supporting Contractor’s PCO must be attached and included for District review and evaluation. Contractor further understands and acknowledges that failure to include documentation sufficient to, in District’s discretion, support some or all of the PCO, shall result in a rejected PCO.

	<u>WORK PERFORMED OTHER THAN BY CONTRACTOR</u>	<u>ADD</u>	<u>DEDUCT</u>
(a)	<u>Material</u> (attach suppliers’ invoice or itemized quantity and unit cost plus sales tax)		
(b)	<u>Add Labor</u> (attach itemized hours and rates, fully encumbered)		
(c)	<u>Add Equipment</u> (attach suppliers’ invoice)		
(d)	<u>Subtotal</u>		
(e)	<u>Add overhead and profit for any and all tiers of Subcontractor</u> , the total not to exceed ten percent (10%) of Item (d)		
(f)	<u>Subtotal</u>		
(g)	<u>Add Overhead and Profit for Contractor</u> , not to exceed five percent (5%) of Item (f)		
(h)	<u>Subtotal</u>		
(i)	<u>Add Bond and Insurance</u> , not to exceed one and a half percent (1.5%) of Item (h)		
(j)	<u>TOTAL</u>		
(k)	<u>Time</u> (zero unless indicated; “TBD” not permitted)	Calendar Days	

[REMAINDER OF PAGE LEFT BLANK INTENTIONALLY]

	WORK PERFORMED BY CONTRACTOR	ADD	DEDUCT
(a)	Material (attach itemized quantity and unit cost plus sales tax)		
(b)	Add Labor (attach itemized hours and rates, fully encumbered)		
(c)	Add Equipment (attach suppliers' invoice)		
(d)	Subtotal		
(e)	Add Overhead and Profit for Contractor , not to exceed fifteen percent (15%) of Item (d)		
(f)	Subtotal		
(g)	Add Bond and Insurance , not to exceed one and a half percent (1.5%) of Item (f)		
(h)	TOTAL		
(i)	Time (zero unless indicated; "TBD" not permitted)	_____ Calendar Days	

The undersigned Contractor approves the foregoing as to the changes, if any, to the Contract Price specified for each item, and as to the extension of time allowed, if any, for completion of the entire Work as stated herein, and agrees to furnish all labor, materials, and service, and perform all work necessary to complete any additional work specified for the consideration stated herein. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 et seq. It is understood that the changes herein to the Contract shall only be effective when approved by the governing board of the District.

It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

SUBMITTED BY:

Contractor:

_____ Date
 [Name]

END OF DOCUMENT

DOCUMENT 00 63 63

CHANGE ORDER FORM

Peralta Community College District
333 East 8th Street
Oakland, CA 94606

CHANGE ORDER NO.:

CHANGE ORDER

Project:
Bid No.:

Date:
DSA File No.:
DSA Appl. No.:

The following parties agree to the terms of this Change Order:

Owner:	[Name / Address]	Contractor:	[Name / Address]
Architect:	[Name / Address]	Project Inspector:	[Name / Address]

Reference	Description	Cost	Days Ext.
PCO # Requested by: Performed by: Reason:	[Description of change] [Requester] [Performer] [Reason]	\$	
PCO # Requested by: Performed by: Reason:	[Description of change] [Requester] [Performer] [Reason]	\$	
PCO # Requested by: Performed by: Reason:	[Description of change] [Requester] [Performer] [Reason]	\$	
Contract time will be adjusted as follows: Previous Completion Date: __[Date] _____[#] Calendar Days Extension (zero unless otherwise indicated) Current Completion Date: __[Date]		Original Contract Amount:	\$
		Amount of Previously Approved Change Order(s):	\$
		Amount of this Change Order:	\$
		Contract Amount:	\$

DOCUMENT 00 65 19.26

AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS

THIS AGREEMENT AND RELEASE OF CLAIMS ("Agreement and Release") IS MADE AND ENTERED INTO THIS _____ DAY OF _____, 20__ by and between the PERALTA COMMUNITY COLLEGE DISTRICT ("District") and _____ ("Contractor"), whose place of business is _____.

RECITALS

WHEREAS, District and Contractor entered into PROJECT/CONTRACT NO.: _____ ("Contract" or "Project") in the County of Alameda, California; and

WHEREAS, the Work under the Contract was completed on _____, and a Notice of Completion was recorded with the County Recorder on _____.

NOW, THEREFORE, it is mutually agreed between District and Contractor as follows:

AGREEMENT AND RELEASE

1. Contractor will only be assessed liquidated damages as detailed below:

Original Contract Sum	\$ _____
Modified Contract Sum	\$ _____
Payment to Date	\$ _____
Liquidated Damages	\$ _____
Payment Due Contractor	\$ _____

2. Subject to the provisions hereof, District shall forthwith pay to Contractor the undisputed sum of _____ Dollars (\$_____) under the Contract, less any amounts represented by any notice to withhold funds on file with District as of the date of such payment.

3. Contractor acknowledges and hereby agrees that there are no unresolved or outstanding claims in dispute against District arising from the performance of work under the Contract, except for the claims described in Paragraph 6 and continuing obligations described in Paragraph 8. It is the intention of the parties in executing this Agreement and Release that this Agreement and Release shall be effective as a full, final and general release of all claims, demands, actions, causes of action, obligations, costs, expenses, damages, losses and liabilities of Contractor against District and all of its respective agents, employees, trustees, inspectors, assignees, consultants and transferees, except for any Disputed Claim that may be set forth in Paragraph 4 and the continuing obligations described in Paragraph 6 hereof.

4. The following claims are disputed (hereinafter, the "Disputed Claims") and are specifically excluded from the operation of this Agreement and Release:

<u>Claim No.</u>	<u>Description of Claim</u>	<u>Amount of Claim</u>	<u>Date Claim Submitted</u>
_____	_____	\$ _____	_____
_____	_____	\$ _____	_____
_____	_____	\$ _____	_____
_____	_____	\$ _____	_____

[If further space is required, attach additional sheets showing the required information.]

5. Consistent with California Public Contract Code section 7100, Contractor hereby agrees that, in consideration of the payment set forth in Paragraph 4 hereof, Contractor hereby releases and forever discharges District, all its agents, employees, inspectors, assignees, and transferees from any and all liability, claims, demands, actions, or causes of action of whatever kind or nature arising out of or in any way concerned with the Work under the Contract.
6. Guarantees and warranties for the Work, and any other continuing obligation of Contractor, including without limitation the duty to defend, indemnify and hold harmless the District, shall remain in full force and effect as specified in the Contract Documents.
7. Contractor hereby waives the provisions of California Civil Code section 1542 which provides as follows:
- A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS THAT THE CREDITOR OR RELEASING PARTY DOES NOT KNOW OR SUSPECT TO EXIST IN HIS OR HER FAVOR AT THE TIME OF EXECUTING THE RELEASE, AND THAT, IF KNOWN BY HIM OR HER WOULD HAVE MATERIALLY AFFECTED HIS OR HER SETTLEMENT WITH THE DEBTOR OR RELEASED PARTY.
8. The provisions of this Agreement and Release are contractual in nature and not mere recitals and shall be considered independent and severable. If any such provision or any part thereof shall be at any time held invalid in whole or in part under any federal, state, county, municipal, or other law, ruling, or regulations, then such provision, or part thereof, shall remain in force and effect to the extent permitted by law, and the remaining provisions of this Agreement and Release shall also remain in full force and effect, and shall be enforceable.

9. All rights of District shall survive completion of the Work or termination of Contract, and execution of this Release.

* * * CAUTION: THIS IS A RELEASE - READ BEFORE EXECUTING * * *

PERALTA COMMUNITY COLLEGE DISTRICT

Signature: _____

Print Name: _____

Title: _____

CONTRACTOR: _____

Signature: _____

Print Name: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00 65 36

GUARANTEE FORM

_____ ("Contractor") hereby agrees that the (_____
_____ "Work" of Contractor) which Contractor has installed for the Peralta
Community College District ("District") for the following project:

PROJECT: MERRITT COLLEGE NEW CHILD DEVELOPMENT CENTER (CDC)_____

("Project" or "Contract") has been performed in accordance with the requirements of the
Contract Documents and that the Work as installed will fulfill the requirements of the
Contract Documents.

The undersigned agrees to repair or replace any or all of such Work that may prove to be
defective in workmanship or material together with any other adjacent Work that may be
displaced in connection with such replacement within a period of two year(s) from the date
of completion as defined in Public Contract Code section 7107, subdivision (c), ordinary
wear and tear and unusual abuse or neglect excepted. The date of completion is
_____, 20____.

In the event of the undersigned's failure to comply with the above-mentioned conditions
within a reasonable period of time, as determined by the District, but not later than seven
(7) days after being notified in writing by the District, the undersigned authorizes the
District to proceed to have said defects repaired and made good at the expense of the
undersigned. The undersigned shall pay the costs and charges therefor upon demand.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

Representatives to be contacted for service subject to terms of Contract:

Name: _____

Address: _____

Phone No.: _____

Email: _____

END OF DOCUMENT

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If District at any time reasonably believes Contractor is or may be in default under this Contract, District may in its sole discretion notify Contractor of this fact and request written assurances from Contractor of performance of Work and a written plan from Contractor to remedy any potential default under the terms this Contract that the District may advise Contractor of in writing. Contractor shall, within ten (10) calendar days of District’s request, deliver a written cure plan that meets the District’s requirements in its request for assurances. Contractor’s failure to provide such written assurances of performance and the required written plan, within ten (10) calendar days of request, will constitute a material breach of this Contract sufficient to justify termination for cause. 78

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GENERAL CONDITIONS**1. CONTRACT TERMS AND DEFINITIONS****1.1 Definitions**

Wherever used in the Contract Documents, the following terms shall have the meanings indicated, which shall be applicable to both the singular and plural thereof:

1.1.1 Adverse Weather: Shall be only weather that satisfies all of the following conditions: (1) unusually severe precipitation, sleet, snow, hail, or extreme temperature conditions in excess of the norm for the location and time of year it occurred based on the closest weather station data averaged over the past five years, (2) that is unanticipated and would cause unsafe work conditions and/or is unsuitable for scheduled work that should not be performed during inclement weather (i.e., exterior finishes), and (3) at the Project.

1.1.2 Allowance Expenditure Directive: Written authorization for expenditure of allowance, if any.

1.1.3 Approval, Approved, and/or Accepted: Written authorization, unless stated otherwise.

1.1.4 Architect (or "Design Professional in General Responsible Charge"): The individual, partnership, corporation, joint venture, or any combination thereof, named as Architect, who will have the rights and authority assigned to the Architect in the Contract Documents. The term Architect means the Design Professional in General Responsible Charge as defined in DSA PR 13-02 on this Project or the Architect's authorized representative.

1.1.5 As-Builts: Electronic files (CADD and PDF) of drawings to be prepared on a monthly basis pursuant to the Contract Documents, that reflect changes made during the performance of the Work, recording differences between the original design of the Work and the Work as constructed since the preceding monthly submittal. See **Record Drawings**.

1.1.6 Bidder: A contractor who intends to provide a proposal to the District to perform the Work of this Contract.

1.1.7 Change Order: A written order to the Contractor authorizing an addition to, deletion from, or revision in the Work, and/or authorizing an adjustment in the Contract Price or Contract Time.

1.1.8 Claim: A Dispute that remains unresolved at the conclusion of the all the applicable Dispute Resolution requirements provided herein.

1.1.9 Construction Change Directive: A written order prepared and issued by the District, the Construction Manager, and/or the Architect and signed by the District and the Architect, directing a change in the Work.

1.1.10 Construction Manager: The individual, partnership, corporation, joint venture, or any combination thereof, or its authorized representative, named as such by the District. If no Construction Manager is used on the Project that is the subject of this Contract, then all references to Construction Manager herein shall be read to refer to District.

1.1.11 Construction Schedule: The progress schedule of construction of the Project as provided by Contractor and approved by District.

1.1.12 Contract, Contract Documents: The Contract consists exclusively of the documents evidencing the agreement of the District and Contractor, identified as the Contract Documents. The Contract Documents consist of the following documents:

- 1.1.12.1** Notice to Bidders
- 1.1.12.2** Instructions to Bidders
- 1.1.12.3** Bid Form and Proposal
- 1.1.12.4** Bid Bond
- 1.1.12.5** Designated Subcontractors List
- 1.1.12.6** Site Visit Certification (if a site visit was required)
- 1.1.12.7** Non-Collusion Declaration
- 1.1.12.8** Notice of Award
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- 1.1.12.10** Agreement
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- 1.1.12.18** Hazardous Materials Procedures and Requirements
- 1.1.12.19** Workers' Compensation Certification
- 1.1.12.20** Prevailing Wage Certification
- 1.1.12.21** Drug-Free Workplace Certification (if applicable)
- 1.1.12.22** Tobacco-Free Environment Certification
- 1.1.12.23** Hazardous Materials Certification (if applicable)
- 1.1.12.24** Lead-Based Materials Certification (if applicable)
- 1.1.12.25** Imported Materials Certification (if applicable)
- 1.1.12.26** Sex Offender Registration Act Certification (if applicable)
- 1.1.12.27** Buy American Certification (if applicable)
- 1.1.12.28** Roofing Project Certification (if applicable)
- 1.1.12.29** Registered Subcontractors List
- 1.1.12.30** Iran Contracting Act Certification (if applicable)
- 1.1.12.31** SLBE/SELBE Self Certification Affidavit (if applicable)
- 1.1.12.32** Post Bid Interview
- 1.1.12.33** All Plans, Technical Specifications, and Drawings

- 1.1.12.34** Any and all addenda to any of the above documents
- 1.1.12.35** Any and all change orders or written modifications to the above documents if approved in writing by the District

1.1.13 Contract Price: The total monies payable to the Contractor under the terms and conditions of the Contract Documents.

1.1.14 Contract Time: The time period stated in the Agreement for the completion of the Work.

1.1.15 Contractor: The person or persons identified in the Agreement as contracting to perform the Work to be done under this Contract, or the legal representative of such a person or persons.

1.1.16 Daily Job Report(s): Daily Project reports prepared by the Contractor's employee(s) who are present on Site, which shall include the information required herein.

1.1.17 Day(s): Unless otherwise designated, day(s) means calendar day(s).

1.1.18 Department of Industrial Relations (or "DIR"): is responsible, among other things, for labor compliance monitoring and enforcement of California prevailing wage laws and regulations for public works contracts.

1.1.19 Design Professional in General Responsible Charge: See definition of **Architect** above.

1.1.20 Dispute: A separate demand by Contractor for a time extension, or payment of money or damages arising from Work done by or on behalf of the Contractor pursuant to the Contract and payment of which is not otherwise expressly provided for or Contractor is not otherwise entitled to; or an amount of payment disputed by the District.

1.1.21 District: The public agency or the district for which the Work is performed. The governing board of the District or its designees will act for the District in all matters pertaining to the Contract. The District may, at any time,

1.1.21.1 Direct the Contractor to communicate with or provide notice to the Construction Manager or the Architect on matters for which the Contract Documents indicate the Contractor will communicate with or provide notice to the District; and/or

1.1.21.2 Direct the Construction Manager or the Architect to communicate with or direct the Contractor on matters for which the Contract Documents indicate the District will communicate with or direct the Contractor.

1.1.22 Drawings (or "Plans"): The graphic and pictorial portions of the Contract Documents showing the design, location, scope and dimensions of the work, generally including plans, elevations, sections, details, schedules, sequence of operation, and diagrams.

1.1.23 DSA: Division of the State Architect.

1.1.24 Force Account Directive: A process that may be used when the District and the Contractor cannot agree on a price for a specific portion of work or before the Contractor prepares a price for a specific portion of work and whereby the Contractor performs the work as indicated herein on a time and materials basis.

1.1.25 Job Cost Reports: Any and all reports or records detailing the costs associated with work performed on or related to the Project that Contractor shall maintain for the Project. Specifically, Job Cost Reports shall contain, but are not limited by or to, the following information: a description of the work performed or to be performed on the Project; quantity, if applicable, of work performed (hours, square feet, cubic yards, pounds, etc.) for the Project; Project budget; costs for the Project to date; estimated costs to complete the Project; and expected costs at completion. The Job Cost Reports shall also reflect all Contract cost codes, change orders, elements of non-conforming work, back charges, and additional services.

1.1.26 Labor Commissioner’s Office (or “Labor Commissioner”, also known as the Division of Labor Standards Enforcement (“DLSE”)): Division of the DIR responsible for adjudicating wage claims, investigating discrimination and public works complaints, and enforcing Labor Code statutes and Industrial Welfare Commission orders.

1.1.27 Municipal Separate Storm Sewer System (or “MS4”): A system of conveyances used to collect and/or convey storm water, including, without limitation, catch basins, curbs, gutters, ditches, man-made channels, and storm drains.

1.1.28 Plans: See **Drawings**.

1.1.29 Premises: The real property owned by the District on which the Site is located.

1.1.30 Product(s): New material, machinery, components, equipment, fixtures and systems forming the Work, including existing materials or components required and approved by the District for reuse.

1.1.31 Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate a material, product, or system for some portion of the Work.

1.1.32 Program Manager: The individual, partnership, corporation, joint venture, or any combination thereof, or its authorized representative, named as such by the District. If no Program Manager is designated for Project that is the subject of this Contract, then all references to Project Manager herein shall be read to refer to District.

1.1.33 Project: The planned undertaking as provided for in the Contract Documents.

1.1.34 Project Inspector (or “Inspector”): The individual(s) retained by the District in accordance with title 24 of the California Code of Regulations to monitor and inspect the Project.

1.1.35 Project Labor Agreement (or "PLA"): a prehire collective bargaining agreement in accordance with Public Contract Code section 2500 *et seq.* that establishes terms and conditions of employment for a specific construction project or projects and/or is an agreement described in Section 158(f) of Title 29 of the United States Code.

1.1.36 Proposed Change Order (or "PCO"): a written request prepared by the Contractor requesting that the District and the Architect issue a Change Order based upon a proposed change to the Work.

1.1.37 Provide: Shall include "provide complete in place," that is, "furnish and install," and "provide complete and functioning as intended in place" unless specifically stated otherwise.

1.1.38 Qualified SWPPP Practitioners (or "QSP"): certified personnel that attended a State Water Resources Control Board sponsored or approved training class and passed the qualifying exam.

1.1.39 Record Drawings: Reproducible (Electronic files) drawings (or Plans) prepared pursuant to the requirements of the Contract Documents that reflect all changes made during the performance of the Work, recording differences between the original design of the Work and the Work as constructed upon completion of the Project. See also **As-Builts**.

1.1.40 Request for Information (or "RFI"): A written request prepared by the Contractor requesting that the Architect provide additional information necessary to clarify or amplify an item in the Contract Documents that the Contractor believes is not clearly shown or called for in the Drawings or Specifications or other portions of the Contract Documents, or to address problems that have arisen under field conditions.

1.1.41 Request for Substitution for Specified Item: A request by Contractor to substitute an equal or superior material, product, thing, or service for a specific material, product, thing, or service that has been designated in the Contract Documents by a specific brand or trade name.

1.1.42 Safety Orders: Written and/or verbal orders for construction issued by the California Division of Occupational Safety and Health ("CalOSHA") or by the United States Occupational Safety and Health Administration ("OSHA").

1.1.43 Safety Plan: Contractor's safety plan specifically adapted for the Project. Contractor's Safety Plan shall comply with all provisions regarding Project safety, including all applicable provisions in these General Conditions.

1.1.44 Samples: Physical examples that illustrate materials, products, equipment, finishes, colors, or workmanship and that, when approved in accordance with the Contract Documents, establish standards by which portions of the Work will be judged.

1.1.45 Shop Drawings: All drawings, prints, diagrams, illustrations, brochures, schedules, and other data that are prepared by the Contractor, a subcontractor, manufacturer, supplier, or distributor, that illustrate how specific portions of the Work shall be fabricated or installed.

1.1.46 Site: The Project site as shown on the Drawings.

1.1.47 Specifications: That portion of the Contract Documents, Division 1 through Division 49, and all technical sections, and addenda to all of these, if any, consisting of written descriptions and requirements of a technical nature of materials, equipment, construction methods and systems, standards, and workmanship.

1.1.48 State: The State of California.

1.1.49 Storm Water Pollution Prevention Plan (or "SWPPP"): A document which identifies sources and activities at a particular facility that may contribute pollutants to storm water and contains specific control measures and time frames to prevent or treat such pollutants.

1.1.50 Subcontractor: A contractor and/or supplier who is under contract with the Contractor or with any other subcontractor, regardless of tier, to perform a portion of the Work of the Project.

1.1.51 Submittal Schedule: The schedule of submittals as provided by Contractor and approved by District.

1.1.52 Surety: The person, firm, or corporation that executes as surety the Contractor's Performance Bond and Payment Bond, and must be a California admitted surety insurer as defined in the Code of Civil Procedure section 995.120.

1.1.53 Work: All labor, materials, equipment, components, appliances, supervision, coordination, and services required by, or reasonably inferred from, the Contract Documents, that are necessary for the construction and completion of the Project.

1.2 Laws Concerning the Contract

Contract is subject to all provisions of the Constitution and laws of California and the United States governing, controlling, or affecting District, or the property, funds, operations, or powers of District, and such provisions are by this reference made a part hereof. Any provision required by law to be included in this Contract shall be deemed to be inserted.

1.3 No Oral Agreements

No oral agreement or conversation with any officer, agent, or employee of District, either before or after execution of Contract, shall affect or modify any of the terms or obligations contained in any of the documents comprising the Contract.

1.4 No Assignment

Contractor shall not assign this Contract or any part thereof including, without limitation, any Work or money to become due hereunder without the prior written consent of the District. Assignment without District's prior written consent shall be null and void. Any assignment of money due or to become due under this Contract shall be subject to a prior lien for services rendered or material supplied for performance of work called for under this Contract in favor of all persons, firms, or corporations rendering services or supplying material to the extent that claims are filed pursuant to the Civil Code, Code of Civil Procedure, Government Code, Labor Code, and/or Public Contract Code, and shall also be subject to deductions for liquidated damages or withholding of payments as determined by District in accordance with this Contract. Contractor shall not assign or transfer in any manner to a Subcontractor or supplier the right to prosecute or maintain an action against the District.

1.5 Notice and Service Thereof

1.5.1 Any notice from one party to the other or otherwise under Contract shall be in writing and shall be dated and signed by the party giving notice or by a duly authorized representative of that party. Any notice shall not be effective for any purpose whatsoever unless served in one of the following manners:

1.5.1.1 If notice is given by personal delivery thereof, it shall be considered delivered on the day of delivery.

1.5.1.2 If notice is given by overnight delivery service, it shall be considered delivered one (1) day after date deposited, as indicated by the delivery service.

1.5.1.3 If notice is given by depositing same in United States mail, enclosed in a sealed envelope, it shall be considered delivered three (3) days after date deposited, as indicated by the postmarked date.

1.5.1.4 If notice is given by registered or certified mail with postage prepaid, return receipt requested, it shall be considered delivered on the day the notice is signed for.

1.5.1.5 Electronic mail may be used for convenience but is not a substitute for the notice and service requirements herein.

1.6 No Waiver

The failure of District in any one or more instances to insist upon strict performance of any of the terms of this Contract or to exercise any option herein conferred shall not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon any such terms or option on any future occasion. No action or failure to act by the District, Architect, or Construction Manager shall constitute a waiver of any right or duty afforded the District under the Contract, nor shall any action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

1.7 Substitutions for Specified Items

1.7.1 Whenever in the Specifications any materials, process, or article is indicated or specified by grade, patent, or proprietary name, or by name of manufacturer, that Specification shall be deemed to be followed by the words "or equal." Contractor may, unless otherwise stated, offer any material, process, or article that shall be substantially equal or better in every respect to that so indicated or specified.

1.7.1.1 If the material, process, or article offered by Contractor is not, in the opinion of the District, substantially equal or better in every respect to that specified, then Contractor shall furnish the material, process, or article specified in the Specifications without any additional compensation or change order.

1.7.1.2 This provision shall not be applicable with respect to any material, product, thing or service for which District made findings and gave notice in accordance with Public Contract Code section 3400(c); therefore, Contractor shall not be entitled to request a substitution with respect to those materials, products or services.

1.7.2 A request for a substitution shall be submitted as follows:

1.7.2.1 Contractor shall notify the District in writing of any request for a substitution at least ten (10) days prior to bid opening as indicated in the Instructions to Bidders.

1.7.2.2 Requests for Substitutions after award of the Contract shall be submitted within thirty-five (35) days of the date of the Notice of Award.

1.7.3 Within 35 days after the date of the Notice of Award, Contractor shall provide data substantiating a request for substitution of "an equal" item, including but not limited to the following:

1.7.3.1 All variations of the proposed substitute from the material specified including, but not limited to, principles of operation, materials, or construction finish, thickness or gauge of materials, dimensions, weight, and tolerances;

1.7.3.2 Available maintenance, repair or replacement services;

1.7.3.3 Increases or decreases in operating, maintenance, repair, replacement, and spare parts costs;

1.7.3.4 Whether or not acceptance of the substitute will require other changes in the Work (or in work performed by the District or others under Contract with the District); and

1.7.3.5 The time impact on any part of the Work resulting directly or indirectly from acceptance of the proposed substitute.

1.7.4 No substitutions shall be made until approved, in writing, by the District. The burden of proof as to equality of any material, process, or article shall rest with Contractor. The Contractor warrants that if substitutes are approved:

1.7.4.1 The proposed substitute is equal or superior in all respects to that specified, and that such proposed substitute is suitable and fit for the intended purpose and will perform adequately the function and achieve the results called for by the general design and the Contract Documents;

1.7.4.2 The Contractor provides the same warranties and guarantees for the substitute that would be provided for that specified;

1.7.4.3 The Contractor shall be fully responsible for the installation of the substitute and any changes in the Work required, either directly or indirectly, because of the acceptance of such substitute, with no increase in Contract Price or Contract Time. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time;

1.7.4.4 The Contractor shall be responsible for any re-design costs occasioned by District's acceptance and/or approval of any substitute; and

1.7.4.5 The Contractor shall, in the event that a substitute is less costly than that specified, credit the District with one hundred percent (100%) of the net difference between the substitute and the originally specified material. In this event, the Contractor agrees to execute a deductive Change Order to reflect that credit.

1.7.5 In the event Contractor furnishes a material, process, or article more expensive than that specified, the difference in the cost of that material, process, or article so furnished shall be borne by Contractor.

1.7.6 In no event shall the District be liable for any increase in Contract Price or Contract Time due to any claimed delay in the evaluation of any proposed substitute or in the acceptance or rejection of any proposed substitute.

1.7.7 Contractor shall be responsible for any costs the District incurs for professional services, DSA fees, or delay to the Project Schedule, if applicable, while DSA reviews changes for the convenience of Contractor and/or to accommodate Contractor's means and methods. District may deduct those costs from any amounts owing to the Contractor for the review of the request for substitution, even if the request for substitution is not approved. District, at its sole discretion, shall deduct from the payments due to and/or invoice Contractor for all the professional services and/or DSA fees or delay to the Project Schedule, if applicable, while DSA reviews changes for the convenience of Contractor and/or to accommodate Contractor's means and methods arising herein.

1.8 Materials and Work

1.8.1 Except as otherwise specifically stated in this Contract, Contractor shall provide and pay for all materials, labor, tools, equipment, transportation,

supervision, temporary constructions of every nature, and all other services, management, and facilities of every nature whatsoever necessary to execute and complete this Contract, in a good and workmanlike manner, within the Contract Time.

1.8.2 Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and grades as noted or specified, workmanship shall be of good quality, and Contractor shall use all diligence to inform itself fully as to the required manufacturer's instructions and to comply therewith.

1.8.3 Materials shall be furnished in ample quantities and at such times as to ensure uninterrupted progress of Work and shall be stored properly and protected from the elements, theft, vandalism, or other loss or damage as required.

1.8.4 For all materials and equipment specified or indicated in the Drawings, the Contractor shall provide all labor, materials, equipment, and services necessary for complete assemblies and complete working systems, functioning as intended. Incidental items not indicated on Drawings, nor mentioned in the Specifications, that can legitimately and reasonably be inferred to belong to the Work described, or be necessary in good practice to provide a complete assembly or system, shall be furnished as though itemized here in every detail. In all instances, material and equipment shall be installed in strict accordance with each manufacturer's most recent published recommendations and specifications.

1.8.5 Contractor shall, after award of Contract by District and after relevant submittals have been approved, place orders for materials and/or equipment as specified so that delivery of same may be made without delays to the Work. Contractor shall, upon five (5) days' demand from District, present documentary evidence showing that orders have been placed.

1.8.6 District reserves the right but has no obligation, in response to Contractor's neglect or failure in complying with the above instructions, to place orders for such materials and/or equipment as the District may deem advisable in order that the Work may be completed at the date specified in the Contract, and all expenses incidental to the procuring of said materials and/or equipment shall be paid for by Contractor or deducted from payment(s) to Contractor.

1.8.7 Contractor warrants good title to all material, supplies, and equipment installed or incorporated in Work and agrees upon completion of all Work to deliver the Site to District, together with all improvements and appurtenances constructed or placed thereon by it, and free from any claims, liens, or charges. Contractor further agrees that neither it nor any person, firm, or corporation furnishing any materials or labor for any work covered by the Contract shall have any right to lien any portion of the Premises or any improvement or appurtenance thereon, except that Contractor may install metering devices or other equipment of utility companies or of political subdivision, title to which is commonly retained by utility company or political subdivision. In the event of installation of any such metering device or equipment, Contractor shall advise District as to owner thereof.

1.8.7.1 If a lien or a claim based on a stop payment notice of any nature should at any time be filed against the Work or any District property, by any entity that has supplied material or services at the request of the Contractor,

Contractor and Contractor's Surety shall promptly, on demand by District and at Contractor's and Surety's own expense, take any and all action necessary to cause any such lien or a claim based on a stop payment notice to be released or discharged immediately therefrom.

1.8.7.2 If the Contractor fails to furnish to the District within ten (10) calendar days after demand by the District, satisfactory evidence that a lien or a claim based on a stop payment notice has been so released, discharged, or secured, the District may discharge such indebtedness and deduct the amount required therefor, together with any and all losses, costs, damages, and attorney's fees and expense incurred or suffered by District from any sum payable to Contractor under the Contract.

1.8.8 Nothing contained in this Article, however, shall defeat or impair the rights of persons furnishing materials or labor under any bond given by Contractor for their protection or any rights under any law permitting such protection or any rights under any law permitting such persons to look to funds due Contractor in hands of District (e.g., stop payment notices), and this provision shall be inserted in all subcontracts and material contracts and notice of its provisions shall be given to all persons furnishing material for work when no formal contract is entered into for such material.

1.8.9 Title to new materials and/or equipment for the Work of this Contract and attendant liability for its protection and safety shall remain with Contractor until incorporated in the Work of this Contract and accepted by District. No part of any materials and/or equipment shall be removed from its place of storage except for immediate installation in the Work of this Contract. Should the District, in its discretion, allow the Contractor to store materials and/or equipment for the Work off-site, Contractor will store said materials and/or equipment at a bonded warehouse and with appropriate insurance coverage at no cost to District. Contractor shall keep an accurate inventory of all materials and/or equipment in a manner satisfactory to District or its authorized representative and shall, at the District's request, forward it to the District.

2. [RESERVED]

3. ARCHITECT

3.1 The Architect shall represent the District during the Project and will observe the progress and quality of the Work on behalf of the District. Architect shall have the authority to act on behalf of District to the extent expressly provided in the Contract Documents and to the extent determined by District. Architect shall have authority to reject materials, workmanship, and/or the Work whenever rejection may be necessary, in Architect's reasonable opinion, to ensure the proper execution of the Contract.

3.2 Architect shall, with the District and on behalf of the District, determine the amount, quality, acceptability, and fitness of all parts of the Work, and interpret the Specifications, Drawings, and shall, with the District, interpret all other Contract Documents.

3.3 Architect shall have all authority and responsibility established by law, including title 24 of the California Code of Regulations.

3.4 Contractor shall provide District and the Construction Manager with a copy of all written communication between Contractor and Architect at the same time as that communication is made to Architect, including, without limitation, all RFIs, correspondence, submittals, claims, and proposed change orders.

4. CONSTRUCTION MANAGER

4.1 If a Construction Manager is used on this Project ("Construction Manager" or "CM"), the Construction Manager will provide administration of the Contract on the District's behalf. After execution of the Contract and Notice to Proceed, all correspondence and/or instructions from Contractor and/or District shall be forwarded through the Construction Manager. The Construction Manager will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences, or procedures or for safety precautions in connection with the Work, which shall all remain the Contractor's responsibility.

4.2 The Construction Manager, however, will have authority to reject materials and/or workmanship not conforming to the Contract Documents, as determined by the District, the Architect, and/or the Project Inspector. The Construction Manager shall also have the authority to require special inspection or testing of any portion of the Work, whether it has been fabricated, installed, or fully completed. Any decision made by the Construction Manager, in good faith, shall not give rise to any duty or responsibility of the Construction Manager to: the Contractor; any Subcontractor; the Contractor or Subcontractor's respective agents, employees; or other persons performing any of the Work. The Construction Manager shall have free access to any or all parts of Work at any time.

4.3 If the District does not use a Construction Manager on this Project, all references within the Contract Documents to Construction Manager or CM shall be read as District.

5. INSPECTOR, INSPECTIONS, AND TESTS

5.1 Project Inspector

5.1.1 One or more Project Inspector(s), including special Project Inspector(s), as required, will be assigned to the Work by District, in accordance with requirements of title 24, part 1, of the California Code of Regulations, to enforce the building code and monitor compliance with Plans and Specifications for the Project previously approved by the DSA. Duties of Project Inspector(s) are specifically defined in section 4-342 of said part 1 of title 24.

5.1.2 No Work shall be carried on except with the knowledge and under the inspection of the Project Inspector(s). The Project Inspector(s) shall have free access to any or all parts of Work at any time. Contractor shall furnish Project Inspector(s) reasonable opportunities for obtaining such information as may be necessary to keep Project Inspector(s) fully informed respecting progress and manner of work and character of materials, including, but not limited to, submission of form DSA 156 (or the most current version applicable at the time the Work is performed) to the Project Inspector at least 48 hours in advance of the commencement and completion of construction of each and every aspect of the Work. Forms are available on the DSA's website at:

<http://www.dgs.ca.gov/dsa/Forms.aspx>. Inspection of Work shall not relieve Contractor from an obligation to fulfill this Contract. Project Inspector(s) and the DSA are authorized to suspend work whenever the Contractor and/or its Subcontractor(s) are not complying with the Contract Documents. Any work stoppage by the Project Inspector(s) and/or DSA shall be without liability to the District. Contractor shall instruct its Subcontractors and employees accordingly.

5.1.3 If Contractor and/or any Subcontractor requests that the Project Inspector(s) perform any inspection off-site, this shall only be done if it is allowable pursuant to applicable regulations and DSA approval, if the Project Inspector(s) agree to do so, and at the expense of the Contractor.

5.2 Tests and Inspections

5.2.1 Tests and Inspections shall comply with title 24, part 1, California Code of Regulations, group 1, article 5, section 4-335, and with the provisions of the Specifications.

5.2.2 The District will select an independent testing laboratory to conduct the tests. Selection of the materials required to be tested shall be by the laboratory or the District's representative and not by the Contractor. The Contractor shall notify the District's representative a sufficient time in advance of its readiness for required observation or inspection.

5.2.3 The Contractor shall notify the District's representative a sufficient time in advance of the manufacture of material to be supplied under the Contract Documents, which must by terms of the Contract Documents be tested, in order that the District may arrange for the testing of same at the source of supply. This notice shall be provided, at a minimum, seventy-two (72) hours prior to the manufacture of the material that needs to be tested.

5.2.4 Any material shipped by the Contractor from the source of supply prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from said representative that such testing and inspection will not be required, shall not be incorporated into and/or onto the Project.

5.2.5 The District will select the testing laboratory and pay for the costs of all tests and inspections, excepting those inspections performed at Contractor's request and expense. Contractor shall reimburse the District for any and all laboratory costs or other testing costs for any materials found to be not in compliance with the Contract Documents. At the District's discretion, District may elect to deduct laboratory or other testing costs for noncompliant materials from the Contract Price, and such deduction shall not constitute a withholding.

5.3 Costs for After Hours and/or Off Site Inspections

If the Contractor performs Work outside the Inspector's regular working hours or requests the Inspector to perform inspections off Site, costs of any inspections required outside regular working hours or off Site shall be borne by the Contractor and may be invoiced to the Contractor by the District or the District may deduct those expenses from the next Progress Payment.

6. CONTRACTOR

Contractor shall construct and complete, in a good and workmanlike manner, the Work for the Contract Price including any adjustment(s) to the Contract Price pursuant to provisions herein regarding changes to the Contract Price. Except as otherwise noted, Contractor shall provide and pay for all labor, materials, equipment, permits (excluding DSA), fees, licenses, facilities, transportation, taxes, bonds and insurance, and services necessary for the proper execution and completion of the Work, except as indicated herein.

6.1 Status of Contractor

6.1.1 Contractor is and shall at all times be deemed to be an independent contractor and shall be wholly responsible for the manner in which it and its Subcontractors perform the services required of it by the Contract Documents. Nothing herein contained shall be construed as creating the relationship of employer and employee, or principal and agent, between the District, or any of the District's employees or agents, and Contractor or any of Contractor's Subcontractors, agents or employees. Contractor assumes exclusively the responsibility for the acts of its agents, and employees as they relate to the services to be provided during the course and scope of their employment. Contractor, its Subcontractors, agents, and its employees shall not be entitled to any rights or privileges of District employees. District shall be permitted to monitor the Contractor's activities to determine compliance with the terms of this Contract.

6.1.2 As required by law, Contractor and all Subcontractors shall be properly licensed and regulated by the Contractors State License Board, 9821 Business Park Drive, Sacramento, California 95827, <http://www.cslb.ca.gov>.

6.1.3 As required by law, Contractor and all Subcontractors shall be properly registered as public works contractors by the Department of Industrial Relations at: <https://efiling.dir.ca.gov/PWCR/ActionServlet?action=displayPWCRRegistrationForm> or current URL.

6.1.4 Contractor represents that it has no existing interest and will not acquire any interest, direct or indirect, which could conflict in any manner or degree with the performance of the Work required under this Contract and that no person having any such interest shall be employed by Contractor.

6.2 Project Inspection Card(s)

Contractor shall verify that forms DSA 152 (or the current version applicable at the time the Work is performed) are issued for the Project prior to the commencement of construction.

6.3 Contractor's Supervision

6.3.1 During progress of the Work, Contractor shall keep on the Premises, and at all other locations where any Work related to the Contract is being performed, an experienced and competent project manager and construction superintendent who are employees of the Contractor, to whom the District does not object and at least one of whom shall be fluent in English, written and verbal.

6.3.2 The project manager and construction superintendent shall both speak fluently the predominant language of the Contractor's employees.

6.3.3 Before commencing the Work herein, Contractor shall give written notice to District of the name of its project manager and construction superintendent. Neither the Contractor's project manager nor construction superintendent shall be changed except with prior written notice to District. If the Contractor's project manager and/or construction superintendent proves to be unsatisfactory to Contractor, or to District, any of the District's employees, agents, the Construction Manager, or the Architect, the unsatisfactory project manager and/or construction superintendent shall be replaced. However, Contractor shall notify District in writing before any change occurs, but no less than two (2) business days prior. Any replacement of the project manager and/or construction superintendent shall be made promptly and must be satisfactory to the District. The Contractor's project manager and construction superintendent shall each represent Contractor, and all directions given to Contractor's project manager and/or construction superintendent shall be as binding as if given to Contractor.

6.3.4 Contractor shall give efficient supervision to Work, using its best skill and attention. Contractor shall carefully study and compare all Contract Documents, Drawings, Specifications, and other instructions and shall at once report to District, Construction Manager, and Architect any error, inconsistency, or omission that Contractor or its employees and Subcontractors may discover, in writing, with a copy to District's Project Inspector(s). The Contractor shall have responsibility for discovery of errors, inconsistencies, or omissions.

6.4 Duty to Provide Fit Workers

6.4.1 Contractor and Subcontractor(s) shall at all times enforce strict discipline and good order among their employees and shall not employ or work any unfit person or anyone not skilled in work assigned to that person. It shall be the responsibility of Contractor to ensure compliance with this requirement. District may require Contractor to permanently remove unfit persons from Project Site.

6.4.2 Any person in the employ of Contractor or Subcontractor(s) whom District may deem incompetent or unfit shall be excluded from working on the Project and shall not again be employed on the Project except with the prior written consent of District.

6.4.3 The Contractor shall furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work.

6.4.4 If Contractor intends to make any change in the name or legal nature of the Contractor's entity, Contractor must first notify the District in writing prior to making any contemplated change. The District shall determine in writing if Contractor's intended change is permissible while performing this Contract.

6.5 Field Office

6.5.1 Contractor shall provide a temporary office on the Site for the District's use exclusively, during the term of the Contract.

6.6 Purchase of Materials and Equipment

The Contractor is required to order, obtain, and store materials and equipment sufficiently in advance of its Work at no additional cost or advance payment from District to assure that there will be no delays.

6.7 Documents on Work

6.7.1 Contractor shall at all times keep on the Site, or at another location as the District may authorize in writing, one (1) legible copy of all Contract Documents, including Addenda and Change Orders, and Titles 19 and 24 of the California Code of Regulations, the specified edition(s) of the Uniform Building Code, all approved Drawings, Plans, Schedules, and Specifications, and all codes and documents referred to in the Specifications, and made part thereof. These documents shall be kept in good order and available to District, Construction Manager, Architect, Architect’s representatives, the Project Inspector(s), and all authorities having jurisdiction. Contractor shall be acquainted with and comply with the provisions of these titles as they relate to this Project. (See particularly the duties of Contractor, Title 24, Part 1, California Code of Regulations, section 4-343.) Contractor shall also be acquainted with and comply with all California Code of Regulations provisions relating to conditions on this Project, particularly Titles 8 and 17. Contractor shall coordinate with Architect and Construction Manager and shall submit its verified report(s) according to the requirements of Title 24.

6.7.2 Daily Job Reports.

6.7.2.1 Contractor shall maintain, at a minimum, at least one (1) set of Daily Job Reports on the Project. These must be prepared by the Contractor’s employee(s) who are present on Site, and must include, at a minimum, the following information:

- 6.7.2.1.1** A brief description of all Work performed on that day.
- 6.7.2.1.2** A summary of all other pertinent events and/or occurrences on that day.
- 6.7.2.1.3** The weather conditions on that day.
- 6.7.2.1.4** A list of all Subcontractor(s) working on that day, including DIR registration numbers.
- 6.7.2.1.5** A list of each Contractor employee working on that day and the total hours worked for each employee.
- 6.7.2.1.6** A complete list of all equipment on Site that day, whether in use or not.
- 6.7.2.1.7** A complete list of all materials, supplies, and equipment delivered on that day.
- 6.7.2.1.8** A complete list of all inspections and tests performed on that day.

6.7.2.2 Each day Contractor shall provide a copy of the previous day’s Daily Job Report to the District or the Construction Manager.

6.8 Preservation of Records

Contractor shall maintain, and District shall have the right to inspect, Contractor's financial records for the Project, including, without limitation, Job Cost Reports for the Project in compliance with the criteria set forth herein. The District shall have the right to examine and audit all Daily Job Reports or other Project records of Contractor's project manager(s), project superintendent(s), and/or project foreperson(s), all certified payroll records and/or related documents including, without limitation, Job Cost Reports, payroll, payment, timekeeping and tracking documents; all books, estimates, records, contracts, documents, bid documents, bid cost data, subcontract job cost reports, and other data of the Contractor, any Subcontractor, and/or supplier, including computations and projections related to bidding, negotiating, pricing, or performing the Work or Contract modification, in order to evaluate the accuracy, completeness, and currency of the cost, manpower, coordination, supervision, or pricing data at no additional cost to the District. These documents may be duplicative and/or be in addition to any Bid Documents held in escrow by the District. The Contractor shall make available at its office at all reasonable times the materials described in this paragraph for the examination, audit, or reproduction until three (3) years after final payment under this Contract. Notwithstanding the provisions above, Contractor shall provide any records requested by any governmental agency, if available, after the time set forth above.

6.9 Integration of Work

6.9.1 Contractor shall do all cutting, fitting, patching, and preparation of Work as required to make its several parts come together properly, to fit it to receive or be received by work of other contractors, and to coordinate tolerances to various pieces of work, showing upon, or reasonably implied by, the Drawings and Specifications for the completed structure, and shall conform them as District and/or Architect may direct.

6.9.2 Contractor shall make its own layout of lines and elevations and shall be responsible for the accuracy of both Contractor's and Subcontractors' work resulting therefrom.

6.9.3 Contractor and all Subcontractors shall take all field dimensions required in performance of the Work, and shall verify all dimensions and conditions on the Site. All dimensions affecting proper fabrication and installation of all Work must be verified prior to fabrication by taking field measurements of the true conditions. If there are any discrepancies between dimensions in drawings and existing conditions which will affect the Work, Contractor shall bring such discrepancies to the attention of the District and Architect for adjustment before proceeding with the Work. In doing so, it is recognized that Contractor is not acting in the capacity of a licensed design professional, and that Contractor's examination is made in good faith to facilitate construction and does not create an affirmative responsibility of a design professional to detect errors, omissions or inconsistencies in the Contract Documents or to ascertain compliance with applicable laws, building codes or regulations. However, nothing in this provision shall abrogate Contractor's responsibilities for discovering and reporting any error, inconsistency, or omission pursuant to the Contract within the Contractor's standard of care including, without limitation, any applicable laws, ordinance, rules, or regulations. Following receipt of written notice from Contractor, the District and/or Architect shall inform Contractor what action, if any, Contractor shall take with regard to such discrepancies.

6.9.4 All costs caused by noncompliant, defective, or delayed Work shall be borne by Contractor, inclusive of repair work.

6.9.5 Contractor shall not endanger any work performed by it or anyone else by cutting, excavating, or otherwise altering work and shall not cut or alter work of any other contractor except with consent of District.

6.10 Notifications

6.10.1 Contractor shall notify the Architect and Project Inspector, in writing, of the commencement of construction of each and every aspect of the Work at least 48 hours in advance by submitting form DSA 156 (or the most current version applicable at the time the Work is performed) to the Project Inspector. Forms are available on the DSA's website at: <http://www.dgs.ca.gov/dsa/Forms.aspx>.

6.10.2 Contractor shall notify the Architect and Project Inspector, in writing, of the completion of construction of each and every aspect of the Work at least 48 hours in advance by submitting form DSA 156 (or current version) to the Project Inspector.

6.11 Obtaining of Permits, Licenses and Registrations

Contractor shall secure and pay for all permits (except DSA), licenses, registrations, approvals and certificates necessary for prosecution of Work, including but not limited to those listed in the Special Conditions, if any, before the date of the commencement of the Work or before the permits, licenses, registrations, approvals and certificates are legally required to continue the Work without interruption. The Contractor shall obtain and pay, only when legally required, for all licenses, registrations, approvals, permits, inspections, and inspection certificates required to be obtained from or issued by any authority having jurisdiction over any part of the Work included in the Contract. All final permits, licenses, registrations, approvals and certificates shall be delivered to District before demand is made for final payment.

6.12 Royalties and Patents

6.12.1 Contractor shall obtain and pay, only when legally required, all royalties and license fees necessary for prosecution of Work before the earlier of the date of the commencement of the Work or the date that the license is legally required to continue the Work without interruption. Contractor shall defend suits or claims of infringement of patent, copyright, or other rights and shall hold the District, the Architect, and the Construction Manager harmless and indemnify them from loss on account thereof except when a particular design, process, or make or model of product is required by the Contract Documents. However, if the Contractor has reason to believe that the required design, process, or product is an infringement of a patent or copyright, the Contractor shall indemnify and defend the District, Architect and Construction Manager against any loss or damage unless the Contractor promptly informs the District of its information.

6.12.2 The review by the District or Architect of any method of construction, invention, appliance, process, article, device, or material of any kind shall be only its adequacy for the Work and shall not approve use by the Contractor in violation of any patent or other rights of any person or entity.

6.13 Work to Comply With Applicable Laws and Regulations

6.13.1 Contractor shall give all notices and comply with the following specific laws, ordinances, rules, and regulations and all other applicable laws, ordinances, rules, and regulations bearing on conduct of Work as indicated and specified, including but not limited to the appropriate statutes and administrative code sections. If Contractor observes that Drawings and Specifications are at variance therewith, or should Contractor become aware of the development of conditions not covered by Contract Documents that may result in finished Work being at variance therewith, Contractor shall promptly notify District in writing and any changes deemed necessary by District shall be made as provided in Contract for changes in Work.

6.13.1.1 National Electrical Safety Code, U. S. Department of Commerce

6.13.1.2 National Board of Fire Underwriters’ Regulations

6.13.1.3 International Building Code, latest addition, and the California Code of Regulations, title 24, and other amendments

6.13.1.4 Manual of Accident Prevention in Construction, latest edition, published by A.G.C. of America

6.13.1.5 Industrial Accident Commission’s Safety Orders, State of California

6.13.1.6 Regulations of the State Fire Marshall (title 19, California Code of Regulations) and Pertinent Local Fire Safety Codes

6.13.1.7 Americans with Disabilities Act

6.13.1.8 Education Code of the State of California

6.13.1.9 Government Code of the State of California

6.13.1.10 Labor Code of the State of California, division 2, part 7, Public Works and Public Agencies

6.13.1.11 Public Contract Code of the State of California

6.13.1.12 California Art Preservation Act

6.13.1.13 U. S. Copyright Act

6.13.1.14 U. S. Visual Artists Rights Act

6.13.2 Contractor shall comply with all applicable mitigation measures, if any, adopted by any public agency with respect to this Project pursuant to the California Environmental Quality Act (Public Resources Code section 21000 et seq.).

6.13.3 If Contractor performs any Work that it knew, or through exercise of reasonable care should have known, to be contrary to any applicable laws,

ordinance, rules, or regulations, Contractor shall bear all costs arising therefrom and arising from the correction of said Work.

6.13.4 Where Specifications or Drawings state that materials, processes, or procedures must be approved by the DSA, State Fire Marshall, or other body or agency, Contractor shall be responsible for satisfying requirements of such bodies or agencies applicable at the time the Work is performed, and as determined by those bodies or agencies.

6.14 Safety/Protection of Persons and Property

6.14.1 The Contractor will be solely and completely responsible for conditions of the Site, including safety of all persons and property during performance of the Work. This requirement will apply continuously and not be limited to normal working hours.

6.14.2 The wearing of hard hats will be mandatory at all times for all personnel on Site. Contractor shall supply sufficient hard hats to properly equip all employees and visitors.

6.14.3 Any construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the Site.

6.14.4 Implementation and maintenance of safety programs shall be the sole responsibility of the Contractor.

6.14.5 The Contractor shall furnish to the District a copy of the Contractor's safety plan within the time frame indicated in the Contract Documents and specifically adapted for the Project.

6.14.6 Contractor shall be responsible for all damages to persons or property that occur as a result of its fault or negligence in connection with the prosecution of this Contract and shall take all necessary measures and be responsible for the proper care and completion and final acceptance by District. All Work shall be solely at Contractor's risk with the exception of damage to the Work caused by "acts of God" as defined in Public Contract Code section 7105.

6.14.7 Contractor shall take, and require Subcontractors to take, all necessary precautions for safety of workers on the Project and shall comply with all applicable federal, state, local, and other safety laws, standards, orders, rules, regulations, and building codes to prevent accidents or injury to persons on, about, or adjacent to premises where Work is being performed and to provide a safe and healthful place of employment. Contractor shall furnish, erect, and properly maintain at all times, all necessary safety devices, safeguards, construction canopies, signs, nets, barriers, lights, and watchmen for protection of workers and the public and shall post danger signs warning against hazards created by such features in the course of construction.

6.14.8 Hazards Control – Contractor shall store volatile wastes in covered metal containers and remove them from the Site daily. Contractor shall prevent accumulation of wastes that create hazardous conditions. Contractor shall provide adequate ventilation during use of volatile or noxious substances.

6.14.9 Contractor shall designate a responsible member of its organization on the Project, whose duty shall be to post information regarding protection and obligations of workers and other notices required under occupational safety and health laws, to comply with reporting and other occupational safety requirements, and to protect the life, safety, and health of workers. Name and position of person so designated shall be reported to District by Contractor.

6.14.10 Contractor shall correct any violations of safety laws, rules, orders, standards, or regulations. Upon the issuance of a citation or notice of violation by the Division of Occupational Safety and Health, Contractor shall correct such violation promptly.

6.14.11 Contractor shall comply with any District storm water requirements that are approved by the District and applicable to the Project, at no additional cost to the District.

6.14.12 In an emergency affecting safety of life or of work or of adjoining property, Contractor, without special instruction or authorization, shall act, at its discretion, to prevent such threatened loss or injury. Any compensation claimed by Contractor on account of emergency work shall be determined by agreement.

6.14.13 All salvage materials will become the property of the Contractor and shall be removed from the Site unless otherwise called for in the Contract Documents. However, the District reserves the right to designate certain items of value that shall be turned over to the District unless otherwise directed by District.

6.14.14 All connections to public utilities and/or existing on-site services shall be made and maintained in such a manner as to not interfere with the continuing use of same by the District during the entire progress of the Work.

6.14.15 Contractor shall provide such heat, covering, and enclosures as are necessary to protect all Work, materials, equipment, appliances, and tools against damage by weather conditions, such as extreme heat, cold, rain, snow, dry winds, flooding, or dampness.

6.14.16 The Contractor shall protect and preserve the Work from all damage or accident, providing any temporary roofs, window and door coverings, boxings, or other construction as required by the Architect. The Contractor shall be responsible for existing structures, walks, roads, trees, landscaping, and/or improvements in working areas; and shall provide adequate protection therefore. If temporary removal is necessary of any of the above items, or damage occurs due to the Work, the Contractor shall replace same at its expense with same kind, quality, and size of Work or item damaged. This shall include any adjoining property of the District and others.

6.14.17 Contractor shall take adequate precautions to protect existing roads, sidewalks, curbs, pavements, utilities, adjoining property, and structures (including, without limitation, protection from settlement or loss of lateral support), and to avoid damage thereto, and repair any damage thereto caused by construction operations.

6.14.18 Contractor shall confine apparatus, the storage of materials, and the operations of workers to limits indicated by law, ordinances, permits, or directions of

Architect, and shall not interfere with the Work or unreasonably encumber Premises or overload any structure with materials. Contractor shall enforce all instructions of District and Architect regarding signs, advertising, fires, and smoking, and require that all workers comply with all regulations while on Project Site.

6.14.19 Contractor, Contractor’s employees, Subcontractors, Subcontractors’ employees, or any person associated with the Work shall conduct themselves in a manner appropriate for a school site. No verbal or physical contact with neighbors, students, and faculty, profanity, or inappropriate attire or behavior will be permitted. District may require Contractor to permanently remove non-complying persons from Project Site.

6.14.20 Contractor shall take care to prevent disturbing or covering any survey markers, monuments, or other devices marking property boundaries or corners. If such markers are disturbed, Contractor shall have a civil engineer, registered as a professional engineer in California, replace them at no cost to District.

6.14.21 In the event that the Contractor enters into any agreement with owners of any adjacent property to enter upon the adjacent property for the purpose of performing the Work, Contractor shall fully indemnify, defend, and hold harmless each person, entity, firm, or agency that owns or has any interest in adjacent property. The form and content of the agreement of indemnification shall be approved by the District prior to the commencement of any Work on or about the adjacent property. The Contractor shall also indemnify the District as provided in the indemnification provision herein. These provisions shall be in addition to any other requirements of the owners of the adjacent property.

6.15 Working Evenings and Weekends

Contractor may be required to work increased hours, evenings, and/or weekends at no additional cost to the District. Contractor shall give the District seventy-two (72) hours’ notice prior to performing any evening and/or weekend work. Contractor shall perform all evening and/or weekend work only upon District’s approval and in compliance with all applicable rules, regulations, laws, and local ordinances including, without limitation, all noise and light limitations. Contractor shall reimburse the District for any increased or additional Inspector charges as a result of Contractor’s increased hours, or evening and/or weekend work.

6.16 Cleaning Up

6.16.1 The Contractor shall provide all services, labor, materials, and equipment necessary for protecting and securing the Work, all school occupants, furnishings, equipment, and building structure from damage until its completion and final acceptance by District. Dust barriers shall be provided to isolate dust and dirt from construction operations. At completion of the Work and portions thereof, Contractor shall clean to the original state any areas beyond the Work area that become dust laden as a result of the Work. The Contractor must erect the necessary warning signs and barricades to ensure the safety of all school occupants. The Contractor at all times must maintain good housekeeping practices to reduce the risk of fire damage and must make a fire extinguisher, fire blanket, and/or fire watch, as applicable, available at each location where cutting, braising, soldering, and/or welding is being performed or where there is an increased risk of fire.

6.16.2 Contractor at all times shall keep Premises, including property immediately adjacent thereto, free from debris such as waste, rubbish (including personal rubbish of workers, e.g., food wrappers, etc.), and excess materials and equipment caused by the Work. Contractor shall not leave debris under, in, or about the Premises (or surrounding property or neighborhood), but shall promptly remove same from the Premises on a daily basis. If Contractor fails to clean up, District may do so and the cost thereof shall be charged to Contractor. If Contract is for work on an existing facility, Contractor shall also perform specific clean-up on or about the Premises upon request by the District as it deems necessary for continued operations. Contractor shall comply with all related provisions of the Specifications.

6.16.3 If the Construction Manager, Architect, or District observes the accumulation of trash and debris, the District will give the Contractor a 24-hour written notice to mitigate the condition.

6.16.4 Should the Contractor fail to perform the required clean-up, or should the clean-up be deemed unsatisfactory by the District, the District may, at its sole discretion, then perform the clean-up. All cost associated with the clean-up work (including all travel, payroll burden, and costs for supervision) will be deducted from the Contract Price.

7. SUBCONTRACTORS

7.1 Contractor shall provide the District with information for all Subcontracts as indicated in the Contractor's Submittals and Schedules Section herein.

7.2 No contractual relationship exists between the District and any Subcontractor, supplier, or sub-subcontractor by reason of this Contract.

7.3 Contractor agrees to bind every Subcontractor by terms of this Contract as far as those terms that are applicable to Subcontractor's work including, without limitation, all labor, wage & hour, apprentice and related provisions and requirements. If Contractor shall subcontract any part of this Contract, Contractor shall be as fully responsible to District for acts and omissions of any Subcontractor and of persons either directly or indirectly employed by any Subcontractor, including Subcontractor caused Project delays, as it is for acts and omissions of persons directly employed by Contractor. The divisions or sections of the Specifications and/or the arrangement of the drawings are not intended to control the Contractor in dividing the Work among Subcontractors or limit the work performed by any trade.

7.4 District's consent to, or approval of, or failure to object to, any Subcontractor under this Contract shall not in any way relieve Contractor of any obligations under this Contract and no such consent shall be deemed to waive any provisions of this Contract.

7.5 Contractor is directed to familiarize itself with sections 4100 through 4114 of the Public Contract Code of the State of California, as regards subletting and subcontracting, and to comply with all applicable requirements therein. In addition, Contractor is directed to familiarize itself with sections 1720 through 1861 of the Labor Code of the State of California, as regards the payment of prevailing wages and related issues, and to comply with all applicable requirements therein including, without

limitation, section 1775 and the Contractor's and Subcontractors' obligations and liability for violations of prevailing wage law and other applicable laws.

7.6 No Contractor whose Bid is accepted shall, without consent of the awarding authority and in full compliance with section 4100 et seq. of the Public Contract Code, including, without limitation, sections 4107, 4107.5, and 4109 of the Public Contract Code, and section 1771.1 of the Labor Code, either:

7.6.1 Substitute any person as a Subcontractor in place of the Subcontractor designated in the original Bid; or

7.6.2 Permit any Subcontract to be assigned or transferred, or allow any portion of the Work to be performed by anyone other than the original Subcontractor listed in the Bid; or

7.6.3 Sublet or subcontract any portion of the Work in excess of one-half of one percent (0.5%) of the Contractor's total bid as to which its original bid did not designate a Subcontractor.

7.7 The Contractor shall be responsible for the coordination of the trades, Subcontractors, sub-subcontractors, and material or equipment suppliers working on the Project.

7.7.1 Contractor is responsible for ensuring that all Subcontractors are properly registered as public works contractors by the Department of Industrial Relations.

7.8 Contractor is solely responsible for settling any differences between the Contractor and its Subcontractor(s) or between Subcontractors.

7.9 Contractor must include in all of its subcontracts the assignment provisions as indicated in the Termination section of these General Conditions.

8. OTHER CONTRACTS/CONTRACTORS

8.1 District reserves the right to let other contracts, and/or to perform work with its own forces, in connection with the Project. Contractor shall afford other contractors reasonable opportunity for introduction and storage of their materials and execution of their work and shall properly coordinate and connect Contractor's Work with the work of other contractors.

8.2 In addition to Contractor's obligation to protect its own Work, Contractor shall protect the work of any other contractor that Contractor encounters while working on the Project.

8.3 If any part of Contractor's Work depends for proper execution or results upon work of District or any other contractor, the Contractor shall inspect and, before proceeding with its Work, promptly report to the District in writing any defects in District's or any other contractor's work that render Contractor's Work unsuitable for proper execution and results. Contractor shall be held accountable for damages to District for District's or any other contractor's work that Contractor failed to inspect or should have inspected. Contractor's failure to inspect and report shall constitute Contractor's acceptance of all District's or any other contractor's work as fit and proper for reception of Contractor's Work, except as to defects that may develop in District's or any other contractor's work after execution of Contractor's Work and not caused by execution of Contractor's Work.

8.4 To ensure proper execution of its subsequent work, Contractor shall measure and inspect work already in place and shall at once report to the District in writing any discrepancy between that executed work and the Contract Documents.

8.5 Contractor shall ascertain to its own satisfaction the scope of the Project and nature of District's or any other contracts that have been or may be awarded by District in prosecution of the Project to the end that Contractor may perform this Contract in light of the other contracts, if any.

8.6 Nothing herein contained shall be interpreted as granting to Contractor exclusive occupancy of the Site, the Premises, or of the Project. Contractor shall not cause any unnecessary hindrance or delay to the use and/or operation(s) of the Premises and/or to District or any other contractor working on the Project. If simultaneous execution of any contract or Premises operation is likely to cause interference with performance of Contractor's Contract, Contractor shall coordinate with

those contractor(s), person(s), and/or entity(s) and shall notify the District of the resolution.

9. DRAWINGS AND SPECIFICATIONS

9.1 A complete list of all Drawings that form a part of the Contract is to be found as an index on the Drawings themselves, and/or may be provided to the Contractor and/or in the Table of Contents.

9.2 Materials or Work described in words that so applied have a well-known technical or trade meaning shall be deemed to refer to recognized standards, unless noted otherwise.

9.3 Trade Name or Trade Term. It is not the intention of this Contract to go into detailed descriptions of any materials and/or methods commonly known to the trade under "trade name" or "trade term." The mere mention or notation of "trade name" or "trade term" shall be considered a sufficient notice to Contractor that it will be required to complete the work so named, complete, finished, and operable, with all its appurtenances, according to the best practices of the trade.

9.4 The naming of any material and/or equipment shall mean furnishing and installing of same, including all incidental and accessory items thereto and/or labor therefor, as per best practices of the trade(s) involved, unless specifically noted otherwise.

9.5 Contract Documents are complementary, and what is called for by one shall be binding as if called for by all. As such, Drawings and Specifications are intended to be fully cooperative and to agree. However, if Contractor observes that Drawings and Specifications are in conflict with the Contract Documents, Contractor shall promptly notify District and Architect in writing, and any necessary changes shall be made as provided in the Contract Documents.

9.6 In the case of discrepancy or ambiguity in the Contract Documents, the order of precedence in the Agreement shall prevail. However, in the case of discrepancy or ambiguity solely between and among the Drawings and Specifications, the discrepancy or ambiguity shall be resolved in favor of the interpretation that will provide District with the functionally complete and operable Project described in the Drawings and Specifications. In case of ambiguity, conflict, or lack of information, District will furnish clarifications with reasonable promptness.

9.7 Drawings and Specifications are intended to comply with all laws, ordinances, rules, and regulations of constituted authorities having jurisdiction, and where referred to in the Contract Documents, the laws, ordinances, rules, and regulations shall be considered as a part of the Contract within the limits specified. Contractor shall bear all expense of correcting work done contrary to said laws, ordinances, rules, and regulations.

9.9 As required by Section 4-317(c), Part 1, Title 24, CCR: "Should any existing conditions such as deterioration or non-complying construction be discovered which is not covered by the DSA-approved documents wherein the finished work will not comply with Title 24, California Code of Regulations, a construction change document, or a

separate set of plans and specifications, detailing and specifying the required repair work shall be submitted to and approved by DSA before proceeding with the repair work.”

9.9 Ownership of Drawings

All copies of Plans, Drawings, Designs, Specifications, and copies of other incidental architectural and engineering work, or copies of other Contract Documents furnished by District, are the property of District. They are not to be used by Contractor in other work and, with the exception of signed sets of Contract Documents, are to be returned to District on request at completion of Work, or may be used by District as it may require without any additional costs to District. Neither the Contractor nor any Subcontractor, or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications, and other documents prepared by the Architect. District hereby grants the Contractor, Subcontractors, sub-subcontractors, and material or equipment suppliers a limited license to use applicable portions of the Drawings prepared for the Project in the execution of their Work under the Contract Documents.

10. CONTRACTOR’S SUBMITTALS AND SCHEDULES

Contractor’s submittals shall comply with the provisions and requirements of the Specifications including, without limitation Submittals.

10.1 Schedule of Work, Schedule of Submittals, and Schedule of Values

10.1.1 Within **TEN (10)** calendar days after the date of the Notice to Proceed (unless otherwise specified in the Specifications), the Contractor shall prepare and submit to the District for review, in a form supported by sufficient data to substantiate its accuracy as the District may require:

10.1.1.1 Preliminary Schedule. A preliminary schedule of construction indicating the starting and completion dates of the various stages of the Work, including any information and following any form as may be specified in the Specifications. Once approved by District, this shall become the Construction Schedule. This schedule shall include and identify all tasks that are on the Project’s critical path with a specific determination of the start and completion of each critical path task as well as all Contract milestones and each milestone’s completion date(s) as may be required by the District.

10.1.1.1.1 The District is not required to approve a preliminary schedule of construction with early completion, i.e., one that shows early completion dates for the Work and/or milestones. Contractor shall not be entitled to extra compensation if the District approves a Construction Schedule with an early completion date and Contractor completes the Project beyond the date shown in the schedule but within the Contract Time. A Construction Schedule showing the Work completed in less than the Contract Time, the time between the early completion date and the end of the Contract Time shall be Float

10.1.1.2 Preliminary Schedule of Values. **Contractor is responsible for providing a Schedule of Values for each Increment (2 Total).** A preliminary schedule of values for all of the Work, which must include quantities and prices of items aggregating the Contract Price and must subdivide the Work

into component parts in sufficient detail to serve as the basis for progress payments during construction. The Preliminary Schedule of Values will include all disciplines and the component parts. Unless the Special Conditions contain different limits, this preliminary schedule of values shall include, at a minimum, the following information and the following structure:

10.1.1.2.1 Divided into at least the following categories:

- 10.1.1.2.1.1** Overhead and profit;
- 10.1.1.2.1.2** Supervision;
- 10.1.1.2.1.3** General conditions;
- 10.1.1.2.1.4** Layout;
- 10.1.1.2.1.5** Mobilization;
- 10.1.1.2.1.6** Submittals;
- 10.1.1.2.1.7** Bonds and insurance;
- 10.1.1.2.1.8** Close-out/Certification documentation;
- 10.1.1.2.1.9** Demolition;
- 10.1.1.2.1.10** Installation;
- 10.1.1.2.1.11** Rough-in;
- 10.1.1.2.1.12** Finishes;
- 10.1.1.2.1.13** Testing;
- 10.1.1.2.1.14** Specification Section;
- 10.1.1.2.1.15** Punchlist and District acceptance.

10.1.1.2.2 And also divided by each of the following areas:

- 10.1.1.2.2.1** Increment;
- 10.1.1.2.2.2** Site work;
- 10.1.1.2.2.3** By each building;
- 10.1.1.2.2.4** By each floor and/or use area;
- 10.1.1.2.2.5** By each roof.

10.1.1.2.3 The preliminary schedule of values shall not provide for values any greater than the following percentages of the Contract value:

- 10.1.1.2.3.1** Mobilization and layout combined to equal not more than 1%;
- 10.1.1.2.3.2** Submittals, samples and shop drawings combined to equal not more than 3%;
- 10.1.1.2.3.3** Bonds and insurance combined to equal not more than 2%.
- 10.1.1.2.3.4** Closeout documentation shall have a value in the preliminary schedule of not less than 5%.

10.1.1.2.4 Notwithstanding any provision of the Contract Documents to the contrary, payment of the Contractor's overhead, supervision, general conditions costs, and profit, as reflected in the Cost Breakdown, shall be paid based on percentage complete, with the disbursement of Progress Payments and the Final Payment.

10.1.1.2.5 Contractor shall certify that the preliminary schedule of values as submitted to the District is accurate and reflects the costs as developed in

preparing Contractor's bid. For example, without limiting the foregoing, Contractor shall not "front-load" the preliminary schedule of values with dollar amounts greater than the value of activities performed early in the Project.

10.1.1.2.6 The preliminary schedule of values shall be subject to the District's review and approval of the form and content thereof. In the event that the District objects to any portion of the preliminary schedule of values, the District shall notify the Contractor, in writing, of the District's objection(s) to the preliminary schedule of values. Within five (5) calendar days of the date of the District's written objection(s), Contractor shall submit a revised preliminary schedule of values to the District for review and approval. The foregoing procedure for the preparation, review and approval of the preliminary schedule of values shall continue until the District has approved the entirety of the preliminary schedule of values.

10.1.1.2.7 Once the preliminary schedule of values is approved by the District, this shall become the Schedule of Values. The Schedule of Values shall not be thereafter modified or amended by the Contractor without the prior consent and approval of the District, which may be granted or withheld in the sole discretion of the District.

10.1.1.3 Preliminary Schedule of Submittals. A preliminary schedule of submittals, including Shop Drawings, Product Data, and Samples submittals. Once approved by District, this shall become the Submittal Schedule. All submittals shall be forwarded to the District by the date indicated on the approved Submittal Schedule, unless an earlier date is necessary to maintain the Construction Schedule, in which case those submittals shall be forwarded to the District so as not to delay the Construction Schedule. Upon request by the District, Contractor shall provide an electronic copy of all submittals to the District. All submittals shall be submitted no later than 90 days after the Notice to Proceed.

10.1.1.4 Safety Plan. Contractor's Safety Plan specifically adapted for the Project. Contractor's Safety Plan shall comply with the following requirements:

10.1.1.4.1 All applicable requirements of California Division of Occupational Safety and Health ("CalOSHA") and/or of the United States Occupational Safety and Health Administration ("OSHA").

10.1.1.4.2 All provisions regarding Project safety, including all applicable provisions in these General Conditions.

10.1.1.4.3 Contractor's Safety Plan shall be in English and in the language(s) of the Contractor's and its Subcontractors' employees.

10.1.1.5 Complete Registered Subcontractors List. The name, address, telephone number, facsimile number, California State Contractors License number, classification, DIR registration number and monetary value of all Subcontracts of any tier for parties furnishing labor, material, or equipment for completion of the Project.

10.1.2 Contractor must provide all schedules both in hard copy and electronically, in a format (e.g., Microsoft Project or Primavera) approved in advance by the District.

10.1.3 The District will review the schedules submitted and the Contractor shall make changes and corrections in the schedules as requested by the District and resubmit the schedules until approved by the District.

10.1.4 The District shall have the right at any time to revise the schedule of values if, in the District's sole opinion, the schedule of values does not accurately reflect the value of the Work performed.

10.1.5 All submittals and schedules must be approved by the District before Contractor can rely on them as a basis for payment.

10.2 Monthly Progress Schedule(s)

10.2.1 Contractor shall provide Monthly Progress Schedule(s) to the District. A Monthly Progress Schedule shall update the approved Construction Schedule or the last Monthly Progress Schedule, showing all work completed and to be completed as well as updating the Registered Subcontractors List. The monthly Progress Schedule shall be sent within the timeframe requested by the District and shall be in a format acceptable to the District and contain a written narrative of the progress of work that month and any changes, delays, or events that may affect the work. The process for District approval of the Monthly Progress Schedule shall be the same as the process for approval of the Construction Schedule.

10.2.2 Contractor shall submit Monthly Progress Schedule(s) with all payment applications.

10.2.3 Contractor must provide all schedules both in hard copy and electronically, in a format (e.g., Microsoft Project or Primavera) approved in advance by the District.

10.2.4 The District will review the schedules submitted and the Contractor shall make changes and corrections in the schedules as requested by the District and resubmit the schedules until approved by the District.

10.2.5 The District shall have the right at any time to revise the schedule of values if, in the District's sole opinion, the schedule of values does not accurately reflect the value of the Work performed.

10.2.6 All submittals and schedules must be approved by the District before Contractor can rely on them as a basis for payment.

10.3 Material Safety Data Sheets (MSDS)

Contractor is required to ensure Material Safety Data Sheets are available in a readily accessible place at the Site for any material requiring a Material Safety Data Sheet per the federal "Hazard Communication" standard, or employees' "right to know" law. The Contractor is also required to ensure proper labeling on substances brought onto the job site and that any person working with the material or within the general area of the

material is informed of the hazards of the substance and follows proper handling and protection procedures. Two additional copies of the Material Safety Data Sheets shall also be submitted directly to the District.

11. SITE ACCESS, CONDITIONS, AND REQUIREMENTS

11.1 Site Investigation

Before bidding on this Work, Contractor shall make a careful investigation of the Site and thoroughly familiarize itself with the requirements of the Contract. By the act of submitting a bid for the Work included in this Contract, Contractor shall be deemed to have made a complete study and investigation, and to be familiar with and accepted the existing conditions of the Site.

Prior to commencing the Work, Contractor and the District's representative shall survey the Site to document the condition of the Site. Contractor will record the survey in digital videotape format and provide an electronic copy to the District within fourteen (14) days of the survey. This electronic record shall serve as a basis for determining any damages caused by the Contractor during the Project. The Contractor may also document any pre-existing conditions in writing, provided that both the Contractor and the District's representative agree on said conditions and sign a memorandum documenting the same.

11.2 Soils Investigation Report

11.2.1 When a soils investigation report obtained from test holes at Site or for the Project is available, that report may be available to the Contractor but shall not be a part of this Contract and shall not alleviate or excuse the Contractor's obligation to perform its own investigation. Any information obtained from that report or any information given on Drawings as to subsurface soil condition or to elevations of existing grades or elevations of underlying rock is approximate only, is not guaranteed, does not form a part of this Contract, and Contractor may not rely thereon. By submitting its bid, Contractor acknowledges that it has made visual examination of Site and has made whatever tests Contractor deems appropriate to determine underground condition of soil. Although any such report is not a part of this Contract, recommendations from the report may be included in the Drawings, Specifications, or other Contract Documents. It is Contractor's sole responsibility to thoroughly review all Contract Documents, Drawings, and Specifications.

11.2.2 Contractor agrees that no claim against District will be made by Contractor for damages and hereby waives any rights to damages if, during progress of Work, Contractor encounters subsurface or latent conditions at Site materially differing from those shown on Drawings or indicated in Specifications, or for unknown conditions of an unusual nature that differ materially from those ordinarily encountered in the work of the character provided for in Plans and Specifications, except as indicated in the provisions of these General Conditions regarding trenches, trenching, and/or existing utility lines.

11.3 Access to Work

District and its representatives shall at all times have access to Work wherever it is in preparation or progress, including storage and fabrication. Contractor shall provide safe

and proper facilities for such access so that District's representatives may perform their functions.

11.4 Layout and Field Engineering

11.4.1 All field engineering required for layout of this Work and establishing grades for earthwork operations shall be furnished by Contractor at its expense. This Work shall be done by a qualified, California-registered civil engineer approved in writing by District and Architect. Any required Record and/or As-Builts of Site development shall be prepared by the approved civil engineer.

11.4.2 The Contractor shall be responsible for having ascertained pertinent local conditions such as location, accessibility, and general character of the Site and for having satisfied itself as to the conditions under which the Work is to be performed. Contractor shall follow best practices, including but not limited to potholing to avoid utilities. District shall not be liable for any claim for allowances because of Contractor's error, failure to follow best practices, or negligence in acquainting itself with the conditions at the Site.

11.4.3 Contractor shall protect and preserve established benchmarks and monuments and shall make no changes in locations without the prior written approval of District. Contractor shall replace any benchmarks or monuments that are lost or destroyed subsequent to proper notification of District and with District's approval.

11.5 Utilities

Utilities shall be provided as indicated in the Specifications.

11.6 Sanitary Facilities

Sanitary facilities shall be provided as indicated in the Specifications.

11.7 Surveys

Contractor shall provide surveys done by a California-licensed civil engineer surveyor to determine locations of construction, grading, and site work as required to perform the Work.

11.8 Regional Notification Center

The Contractor, except in an emergency, shall contact the appropriate regional notification center at least two (2) days prior to commencing any excavation if the excavation will be conducted in an area or in a private easement that is known, or reasonably should be known, to contain subsurface installations other than the underground facilities owned or operated by the District, and obtain an inquiry identification number from that notification center. No excavation shall be commenced and/or carried out by the Contractor unless an inquiry identification number has been assigned to the Contractor or any Subcontractor and the Contractor has given the District the identification number. Any damages arising from Contractor's failure to make appropriate notification shall be at the sole risk and expense of the Contractor.

Any delays caused by failure to make appropriate notification shall be at the sole risk of the Contractor and shall not be considered for an extension of the Contract Time.

11.9 Existing Utility Lines

11.9.1 Pursuant to Government Code section 4215, District assumes the responsibility for removal, relocation, and protection of main or trunk utility lines and facilities located on the construction Site at the time of commencement of construction under this Contract with respect to any such utility facilities that are not identified in the Plans and Specifications. Contractor shall not be assessed for liquidated damages for delay in completion of the Project caused by failure of District or the owner of a utility to provide for removal or relocation of such utility facilities.

11.9.2 Locations of existing utilities provided by District shall not be considered exact, but approximate within a reasonable margin and shall not relieve Contractor of responsibilities to exercise reasonable care or costs of repair due to Contractor's failure to do so. District shall compensate Contractor for the costs of locating and repairing damage not due to the failure of Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Plans and Specifications with reasonable accuracy, and for equipment necessarily idle during such work.

11.9.3 No provision herein shall be construed to preclude assessment against Contractor for any other delays in completion of the Work. Nothing in this Article shall be deemed to require District to indicate the presence of existing service laterals, appurtenances, or other utility lines, within the exception of main or trunk utility lines or whenever the presence of these utilities on the Site of the construction Project can be inferred from the presence of other visible facilities, such as buildings, meter junction boxes, on or adjacent to the Site of the construction.

11.9.4 If Contractor, while performing Work under this Contract, discovers utility facilities not identified by District in Contract Plans and Specifications, Contractor shall immediately notify the District and the utility in writing. The cost of repair for damage to above-mentioned visible facilities without prior written notification to the District shall be borne by the Contractor.

11.10 Notification

Contractor understands, acknowledges and agrees that the purpose of prompt notification to the District pursuant to these provisions is to allow the District to investigate the condition(s) so that the District shall have the opportunity to decide how the District desires to proceed as a result of the condition(s). Accordingly, failure of Contractor to promptly notify the District in writing, pursuant to these provisions, shall constitute Contractor's waiver of any claim for damages or delay incurred as a result of the condition(s).

11.11 Hazardous Materials

Contractor shall comply with all provisions and requirements of the Contract Documents related to hazardous materials including, without limitation, Hazardous Materials Procedures and Requirements.

11.12 No Signs

Neither the Contractor nor any other person or entity shall display any signs not required by law or the Contract Documents at the Site, fences trailers, offices, or elsewhere on the Site without specific prior written approval of the District.

12. TRENCHES

12.1 Trenches Greater Than Five Feet

Pursuant to Labor Code section 6705, if the Contract Price exceeds \$25,000 and involves the excavation of any trench or trenches five (5) feet or more in depth, the Contractor shall, in advance of excavation, promptly submit to the District and/or a registered civil or structural engineer employed by the District or Architect, a detailed plan, stamped by a licensed engineer retained by the Contractor, showing the design of shoring for protection from the hazard of caving ground during the excavation of such trench or trenches.

12.2 Excavation Safety

If such plan varies from the Shoring System Standards established by the Construction Safety Orders, the plan shall be prepared by a registered civil or structural engineer, but in no case shall such plan be less effective than that required by the Construction Safety Orders. No excavation of such trench or trenches shall be commenced until said plan has been accepted by the District or by the person to whom authority to accept has been delegated by the District.

12.3 No Tort Liability of District

Pursuant to Labor Code section 6705, nothing in this Article shall impose tort liability upon the District or any of its employees.

12.4 No Excavation without Permits

The Contractor shall not commence any excavation Work until it has secured all necessary permits including the required CalOSHA excavation/shoring permit. Any permits shall be prominently displayed on the Site prior to the commencement of any excavation.

12.5 Discovery of Hazardous Waste and/or Unusual Conditions

12.5.1 Pursuant to Public Contract Code section 7104, if the Work involves digging trenches or other excavations that extend deeper than four feet below the Surface, the Contractor shall promptly, and before the following conditions are disturbed, notify the District, in writing, of any:

12.5.1.1 Material that the Contractor believes may be material that is hazardous waste, as defined in section 25117 of the Health and Safety Code, is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.

12.5.1.2 Subsurface or latent physical conditions at the Site differing from those indicated.

12.5.1.3 Unknown physical conditions at the Site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

12.5.2 The District shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the Work, shall issue a Change Order under the procedures described herein.

12.5.3 In the event that a dispute arises between District and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the Work, the Contractor shall not be excused from any scheduled completion date provided for by the Contract, but shall proceed with all work to be performed under the Contract. The Contractor shall retain any and all rights provided either by Contract or by law that pertain to the resolution of disputes and protests.

13. INSURANCE AND BONDS

13.1 Insurance

Unless different provisions and/or limits are indicated in the Special Conditions, all insurance required of Contractor and/or its Subcontractor(s) shall be at least as broad as the amounts and include the provisions set forth herein.

13.1.1 Commercial General Liability and Automobile Liability Insurance

13.1.1.1 Contractor shall procure and maintain, during the life of this Contract, Commercial General Liability Insurance and Automobile Liability Insurance that shall protect Contractor, District, State, Construction Manager(s), Project Inspector(s), and Architect(s) from all claims for bodily injury, property damage, personal injury, death, advertising injury, and medical payments arising from, or in connection with, operations under this Contract. This coverage shall be provided in a form at least as broad as Insurance Services (ISO) Form CG 0001 11188. Contractor shall ensure that Products Liability and Completed Operations coverage, Fire Damage Liability coverage, and Automobile Liability Insurance coverage including owned, non-owned, and hired automobiles, are included within the above policies and at the required limits, or Contractor shall procure and maintain these coverages separately.

13.1.1.2 Contractor's deductible or self-insured retention for its Commercial General Liability Insurance policy shall not exceed \$25,000 unless approved in writing by District.

13.1.1.3 All such policies shall be written on an occurrence form.

13.1.2 Excess Liability Insurance

13.1.2.1 If Contractor's underlying policy limits are less than required, subject to the District's sole discretion, Contractor may procure and maintain, during the life of this Contract, an Excess Liability Insurance Policy to meet the policy limit requirements of the required policies in order to satisfy, in the aggregate with its underlying policy, the insurance requirements herein.

13.1.2.2 There shall be no gap between the per occurrence amount of any underlying policy and the start of the coverage under the Excess Liability Insurance Policy. Any Excess Liability Insurance Policy shall be written on a following form and shall protect Contractor, District, State, Construction Manager(s), Project Manager(s), and Architect(s) in amounts and including the provisions as set forth in the Supplementary Conditions (if any) and/or Special Conditions, and that complies with all requirements for Commercial General Liability and Automobile Liability and Employers' Liability Insurance.

13.1.2.3 The District, in its sole discretion, may accept an Excess Liability Insurance Policy that brings Contractor's primary limits to the minimum requirements herein.

13.1.3 Subcontractor(s): Contractor shall require its Subcontractor(s), if any, to procure and maintain Commercial General Liability Insurance, Automobile Liability Insurance, and Excess Liability Insurance (if Subcontractor elects to satisfy, in part the insurance required herein by procuring and maintaining an Excess Liability Insurance Policy) with forms of coverage and limits equal to the amounts required of the Contractor.

13.1.4 Workers' Compensation and Employers' Liability Insurance

13.1.4.1 In accordance with provisions of section 3700 of the California Labor Code, the Contractor and every Subcontractor shall be required to secure the payment of compensation to its employees.

13.1.4.2 Contractor shall procure and maintain, during the life of this Contract, Workers' Compensation Insurance and Employers' Liability Insurance for all of its employees engaged in work under this Contract, on/or at the Site of the Project. This coverage shall cover, at a minimum, medical and surgical treatment, disability benefits, rehabilitation therapy, and survivors' death benefits. Contractor shall require its Subcontractor(s), if any, to procure and maintain Workers' Compensation Insurance and Employers' Liability Insurance for all employees of Subcontractor(s). Any class of employee or employees not covered by a Subcontractor's insurance shall be covered by Contractor's insurance. If any class of employee or employee engaged in Work under this Contract, on or at the Site of the Project, is not protected under the Workers' Compensation Insurance, Contractor shall provide, or shall cause a Subcontractor to provide, adequate insurance coverage for the protection of any employee(s) not otherwise protected before any of those employee(s) commence work.

13.1.5 Builder's Risk Insurance: Builder's Risk "All Risk" Insurance

Contractor shall procure and maintain, during the life of this Contract, Builder's Risk (Course of Construction), or similar first party property coverage acceptable to the District, issued on a replacement cost value basis. The cost shall be consistent with

the total replacement cost of all insurable Work of the Project included within the Contract Documents. Coverage is to insure against all risks of accidental physical loss and shall include without limitation the perils of vandalism and/or malicious mischief (both without any limitation regarding vacancy or occupancy), sprinkler leakage, civil authority, theft, sonic disturbance, earthquake, flood, collapse, wind, rain, dust, fire, war, terrorism, lightning, smoke, and rioting. Coverage shall include debris removal, demolition, increased costs due to enforcement of all applicable ordinances and/or laws in the repair and replacement of damaged and undamaged portions of the property, and reasonable costs for the Architect's and engineering services and expenses required as a result of any insured loss upon the Work and Project, including completed Work and Work in progress, to the full insurable value thereof.

13.1.6 Pollution Liability Insurance

13.1.6.1 Contractor shall procure and maintain Pollution Liability Insurance that shall protect Contractor, District, State, Construction Manager(s), Project Inspector(s), and Architect(s) from all claims for bodily injury, property damage, including natural resource damage, cleanup costs, removal, storage, disposal, and/or use of the pollutant arising from operations under this Contract, and defense, including costs and expenses incurred in the investigation, defense, or settlement of claims. Coverage shall apply to sudden and/or gradual pollution conditions resulting from the escape or release of smoke, vapors, fumes, acids, alkalis, toxic chemicals, liquids, or gases, natural gas, waste materials, or other irritants, contaminants, or pollutants, including asbestos. This coverage shall be provided in a form at least as broad as Insurance Services Offices, Inc. (ISO) Form CG 2415, or Contractor shall procure and maintain these coverages separately.

13.1.6.2 Contractor warrants that any retroactive date applicable to coverage under the policy shall predate the effective date of the Contract and that continuous coverage will be maintained or an extended reporting or discovery period will be exercised for a period of three (3) years, beginning from the time that the Work under the Contract is completed.

13.1.6.3 If Contractor is responsible for removing any pollutants from a site, then Contractor shall ensure that Any Auto, including owned, non-owned, and hired, is included within the above policies and at the required limits, to cover its automobile exposure from transporting the pollutants from the site to an approved disposal site. This coverage shall include the Motor Carrier Act Endorsement, MCS 90.

13.1.7 Proof of Insurance and Other Requirements: Endorsements and Certificates

13.1.7.1 Contractor shall not commence Work nor shall it allow any Subcontractor to commence Work under this Contract, until Contractor and its Subcontractor(s) have procured all required insurance and Contractor has delivered in duplicate to the District complete endorsements (or entire insurance policies) and certificates indicating the required coverages have been obtained, and the District has approved these documents.

13.1.7.2 Endorsements, certificates, and insurance policies shall include the following:

13.1.7.2.1 A clause stating the following, or other language acceptable to the District:

"This policy shall not be canceled until written notice to District, Architect, and Construction Manager stating date of the cancellation by the insurance carrier. Date of cancellation may not be less than thirty (30) days after date of mailing notice."

13.1.7.2.2 Language stating in particular those insured, extent of insurance, location and operation to which insurance applies, expiration date, to whom cancellation and reduction notice will be sent, and length of notice period.

13.1.7.2.3 All endorsements, certificates and insurance policies shall state that District, its trustees, employees and agents, the State of California, Construction Manager(s), Project Manager(s), Inspector(s) and Architect(s) are named additional insureds under all policies except Workers' Compensation Insurance and Employers' Liability Insurance.

13.1.7.2.4 All endorsements shall waive any right to subrogation against any of the named additional insureds.

13.1.7.2.5 Contractor's and Subcontractors' insurance policy(s) shall be primary and non-contributory to any insurance or self-insurance maintained by District, its trustees, employees and/or agents, the State of California, Construction Manager(s), Project Manager(s), Inspector(s), and/or Architect(s).

13.1.7.2.6 Contractor's insurance limit shall apply separately to each insured against whom a claim is made or suit is brought.

13.1.7.3 No policy shall be amended, canceled or modified, and the coverage amounts shall not be reduced, until Contractor or Contractor's broker has provided written notice to District, Architect(s), and Construction Manager(s) stating date of the amendment, modification, cancellation or reduction, and a description of the change. Date of amendment, modification, cancellation or reduction may not be less than thirty (30) days after date of mailing notice.

13.1.7.4 Insurance written on a "claims made" basis shall be retroactive to a date that coincides with or precedes Contractor's commencement of Work, including subsequent policies purchased as renewals or replacements. Said policy is to be renewed by the Contractor and all Subcontractors for a period of five (5) years following completion of the Work or termination of this Agreement. Such insurance must have the same coverage and limits as the policy that was in effect during the term of this Agreement, and will cover the Contractor and all Subcontractors for all claims made.

13.1.7.5 Unless otherwise stated in the Special Conditions, all of Contractor’s insurance shall be with insurance companies with an A.M. Best rating of no less than **A: VII**.

13.1.7.6 The insurance requirements set forth herein shall in no way limit the Contractor’s liability arising out of or relating to the performance of the Work or related activities.

13.1.7.7 Failure of Contractor and/or its Subcontractor(s) to comply with the insurance requirements herein shall be deemed a material breach of the Contract.

13.1.8 Insurance Policy Limits

13.1.8.1 Unless different limits are indicated in the Special Conditions, the limits of insurance shall not be less than the following amounts:

Commercial General Liability	Product Liability and Completed Operations, Fire Damage Liability – Split Limit	\$2,000,000 per occurrence; \$4,000,000 aggregate
Automobile Liability – Any Auto	Combined Single Limit	\$1,000,000
Workers’ Compensation		Statutory limits pursuant to State law
Employers’ Liability		\$1,000,000
Builder’s Risk (Course of Construction)		Issued for the value and scope of Work indicated herein.
Pollution Liability		\$1,000,000 per claim; \$2,000,000 aggregate

13.1.8.2 If Contractor normally carries insurance in an amount greater than the minimum amounts required by District, that greater amount shall become the minimum required amount of insurance for purposes of the Contract. Therefore, Contractor hereby acknowledges and agrees that all insurance carried by it shall be deemed liability coverage for all actions it performs in connection with the Contract.

13.2 Contract Security - Bonds

13.2.1 Contractor shall furnish two surety bonds issued by a California admitted surety insurer as follows:

13.2.1.1 Performance Bond: A bond in an amount at least equal to one hundred percent (100%) of Contract Price as security for faithful performance of this Contract.

13.2.1.2 Payment Bond: A bond in an amount at least equal to one hundred percent (100%) of the Contract Price as security for payment of persons performing labor and/or furnishing materials in connection with this Contract.

13.2.2 Cost of bonds shall be included in the Bid and Contract Price.

13.2.3 All bonds related to this Project shall be in the forms set forth in these Contract Documents and shall comply with all requirements of the Contract Documents, including, without limitation, the bond forms.

14. WARRANTY/GUARANTEE/INDEMNITY

14.1 Warranty/Guarantee

14.1.1 The Contractor shall obtain and preserve for the benefit of the District, manufacturer's warranties on materials, fixtures, and equipment incorporated into the Work.

14.1.2 In addition to guarantees required elsewhere, Contractor shall, and hereby does guarantee and warrant all Work furnished on the job against all defects for a period of **TWO (2)** years after the later of the following dates, unless a longer period is provided for in the Contract Documents:

14.1.2.1 The acceptance by the District's governing board of the Work, subject to these General Conditions, or

14.1.2.2 The date that commissioning for the Project, if any, was completed.

At the District's sole option, Contractor shall repair or replace any and all of that Work, together with any other Work that may be displaced in so doing, that may prove defective in workmanship and/or materials within a **TWO (2)** year period from date of completion as defined above, unless a longer period is provided for in the Contract Documents, without expense whatsoever to District. In the event of failure of Contractor and/or Surety to commence and pursue with diligence said replacements or repairs within ten (10) days after being notified in writing, Contractor and Surety hereby acknowledge and agree that District is authorized to proceed to have defects repaired and made good at expense of Contractor and/or Surety who hereby agree to pay costs and charges therefore immediately on demand.

14.1.3 If, in the opinion of District, defective work creates a dangerous condition or requires immediate correction or attention to prevent further loss to District or to prevent interruption of District operations, District will attempt to give the notice required above. If Contractor or Surety cannot be contacted or neither complies with District's request for correction within a reasonable time as determined by District, District may, notwithstanding the above provision, proceed to make any and all corrections and/or provide attentions the District believes are necessary. The costs

of correction or attention shall be charged against Contractor and Surety of the guarantees provided in this Article or elsewhere in this Contract.

14.1.4 The above provisions do not in any way limit the guarantees on any items for which a longer guarantee is specified or on any items for which a manufacturer gives a guarantee for a longer period. Contractor shall furnish to District all appropriate guarantee or warranty certificates as indicated in the Specifications or upon request by District.

14.1.5 Nothing herein shall limit any other rights or remedies available to District.

14.2 Indemnity and Defense

14.2.1 To the furthest extent permitted by California law, the Contractor shall indemnify, keep and hold harmless the District, the Architect(s), and the Construction Manager(s), their respective consultants, separate contractors, board members, officers, representatives, agents, and employees, in both individual and official capacities ("Indemnitees"), against all suits, claims, injury, damages, losses, and expenses ("Claims"), including but not limited to attorney's fees, caused by, arising out of, resulting from, or incidental to, in whole or in part, the performance of the Work under this Contract by the Contractor, its Subcontractors, vendors, or suppliers. However, the Contractor's indemnification and hold harmless obligation shall be reduced by the proportion of the Indemnitees' and/or Architect's liability to the extent the Claim(s) is/are caused by the sole negligence, active negligence, or willful misconduct of the Indemnitees, and/or defects in design furnished by the Architect, as found by a court or arbitrator of competent jurisdiction. This indemnification and hold harmless obligation of the Contractor shall not be construed to negate, abridge, or otherwise reduce any right or obligation of indemnity that would otherwise exist or arise as to Indemnitee or other person described herein. This indemnification and hold harmless obligation includes, but is not limited to, any failure or alleged failure by Contractor to comply with any provision of law, any failure or alleged failure to timely and properly fulfill all of its obligations under the Contract Documents in strict accordance with their terms, and without limitation, any failure or alleged failure of Contractor's obligations regarding any stop payment notice actions or liens, including Civil Wage and Penalty Assessments and/or Orders by the DIR.

14.2.2 To the furthest extent permitted by California law, Contractor shall also defend Indemnitees, at its own expense, including but not limited to attorneys' fees and costs, against all Claims caused by, arising out of, resulting from, or incidental to, in whole or in part, the performance of the Work under this Contract by the Contractor, its Subcontractors, vendors, or suppliers. However, without impacting Contractor's obligation to provide an immediate and ongoing defense of Indemnitees, the Contractor's defense obligation shall be retroactively reduced by the proportion of the Indemnitees' and/or Architect's liability to the extent caused by the sole negligence, active negligence, or willful misconduct of the Indemnitees, and/or defects in design furnished by the Architect, as found by a court or arbitrator of competent jurisdiction. The District shall have the right to accept or reject any legal representation that Contractor proposes to defend the Indemnitees. If any Indemnitee provides its own defense due to failure to timely respond to tender of defense, rejection of tender of defense, or conflict of interest of proposed counsel, Contractor shall reimburse such Indemnitee for any expenditures. Contractor's

defense obligation shall not be construed to negate, abridge, or otherwise reduce any right or obligation of defense that would otherwise exist as to any Indemnitee or other person described herein. Contractor's defense obligation includes, but is not limited to, any failure or alleged failure by Contractor to comply with any provision of law, any failure or alleged failure to timely and properly fulfill all of its obligations under the Contract Documents in strict accordance with their terms, and without limitation, any failure or alleged failure of Contractor's obligations regarding any stop payment notice actions or liens, including Civil Wage and Penalty Assessments and/or Orders by the DIR. The Contractor shall give prompt notice to the District in the event of any Claim(s).

14.2.3 Without limitation of the provisions herein, if the Contractor's obligation to indemnify and hold harmless the Indemnitees or its obligation to defend Indemnitees as provided herein shall be determined to be void or unenforceable, in whole or in part, it is the intention of the parties that these circumstances shall not otherwise affect the validity or enforceability of the Contractor's agreement to indemnify, defend, and hold harmless the rest of the Indemnitees, as provided herein. Further, the Contractor shall be and remain fully liable on its agreements and obligations herein to the fullest extent permitted by law.

14.2.4 Pursuant to Public Contract Code section 9201, the District shall provide timely notification to Contractor of the receipt of any third-party claim relating to this Contract. The District shall be entitled to recover its reasonable costs incurred in providing said notification.

14.2.5 In any and all claims against any of the Indemnitees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the Contractor's indemnification obligation herein shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Contractor or any Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

14.2.6 The District may retain so much of the moneys due the Contractor as shall be considered necessary, until disposition of any such Claims or until the District, Architect(s) and Construction Manager(s) have received written agreement from the Contractor that they will unconditionally defend the District, Architect(s) and Construction Manager(s), their respective officers, agents and employees, and pay any damages due by reason of settlement or judgment.

14.2.7 The Contractor's defense and indemnification obligations hereunder shall survive the completion of Work, the warranty/guarantee period, and the termination of the Contract.

15. TIME

15.1 Notice to Proceed

15.1.1 District may issue a Notice to Proceed within ninety (90) days from the date of the Notice of Award. Once Contractor has received the Notice to Proceed, Contractor shall complete the Work within the period of time indicated in the Contract Documents.

15.1.2 In the event that the District desires to postpone issuing the Notice to Proceed beyond ninety (90) days from the date of the Notice of Award, it is expressly understood that with reasonable notice to the Contractor, the District may postpone issuing the Notice to Proceed. It is further expressly understood by Contractor that Contractor shall not be entitled to any claim of additional compensation as a result of the postponement of the issuance of the Notice to Proceed.

15.1.3 If the Contractor believes that a postponement of issuance of the Notice to Proceed will cause a hardship to Contractor, Contractor may terminate the Contract. Contractor's termination due to a postponement shall be by written notice to District within ten (10) days after receipt by Contractor of District's notice of postponement. It is further understood by Contractor that in the event that Contractor terminates the Contract as a result of postponement by the District, the District shall only be obligated to pay Contractor for the Work that Contractor had performed at the time of notification of postponement. Should Contractor terminate the Contract as a result of a notice of postponement, District shall have the authority to award the Contract to the next lowest responsive responsible bidder.

15.2 Computation of Time / Adverse Weather

15.2.1 The Contractor will only be allowed a time extension for Adverse Weather conditions if requested by Contractor in compliance with the time extension request procedures and only if all of the following conditions are met:

15.2.1.1 The weather conditions constitute Adverse Weather, as defined herein and further specified in the Special Conditions;

15.2.1.2 Contractor can verify that the Adverse Weather caused delays in excess of five (5) hours of the indicated labor required to complete the scheduled tasks of Work on the day affected by the Adverse Weather;

15.2.1.3 The Contractor's crew is dismissed as a result of the Adverse Weather;

15.2.1.4 Said delay adversely affects the critical path in the Construction Schedule; and

15.2.1.5 Exceeds sixty-three (63) days of delay per year.

15.2.2 If the aforementioned conditions are met, a non-compensable day-for-day extension will only be allowed for those days in excess of those indicated in the Special Conditions.

15.2.3 The Contractor shall work seven (7) days per week, if necessary, irrespective of inclement weather, to maintain access and the Construction Schedule, and to protect the Work under construction from the effects of Adverse Weather, all at no further cost to the District.

15.2.4 The Contract Time has been determined with consideration given to the average climate weather conditions prevailing in the County in which the Project is located.

15.3 Hours of Work

15.3.1 Sufficient Forces

Contractor and Subcontractors shall continuously furnish sufficient and competent work forces with the required levels of familiarity with the Project and skill, training and experience to ensure the prosecution of the Work in accordance with the Construction Schedule.

15.3.2 Performance During Working Hours

Work shall be performed during regular working hours as permitted by the appropriate governmental agency except that in the event of an emergency, or when required to complete the Work in accordance with job progress, Work may be performed outside of regular working hours with the advance written consent of the District and approval of any required governmental agencies.

15.3.3 No Work during Testing

Contractor shall, at no additional cost to the District and at the District's request, coordinate its Work to not disturb District students including, without limitation, not performing any Work when students at the Site are taking tests. The District or District's Representative will provide Contractor with a schedule of test dates concurrent with the District's issuance of the Notice to Proceed, or as soon as test dates are made available to the District.

15.4 Progress and Completion

15.4.1 Time of the Essence

Time limits stated in the Contract Documents are of the essence to the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

15.4.2 No Commencement Without Insurance or Bonds

The Contractor shall not commence operations on the Project or elsewhere prior to the effective date of insurance and bonds. The date of commencement of the Work shall not be changed by the effective date of such insurance or bonds. If Contractor commences Work without insurance and bonds, all Work is performed at Contractor's peril and shall not be compensable until and unless Contractor secures bonds and insurance pursuant to the terms of the Contract Documents and subject to District claim for damages.

15.5 Schedule

Contractor shall provide to District, Construction Manager, and Architect a schedule in conformance with the Contract Documents and as required in the Notice to Proceed and the Contractor's Submittals and Schedules section of these General Conditions.

15.6 Expeditious Completion

The Contractor shall proceed expeditiously with adequate forces and shall achieve Completion within the Contract Time.

16. EXTENSIONS OF TIME – LIQUIDATED DAMAGES

16.1 Liquidated Damages

Contractor and District hereby agree that the exact amount of damages for failure to complete the Work within the time specified is extremely difficult or impossible to determine. If the Work is not completed within the time specified in the Contract Documents, it is understood that the District will suffer damage. It being impractical and unfeasible to determine the amount of actual damage, it is agreed the Contractor shall pay to District as fixed and liquidated damages, and not as a penalty, the amount set forth in the Agreement for each calendar day of delay in completion. Contractor and its Surety shall be liable for the amount thereof pursuant to Government Code section 53069.85.

16.2 Excusable Delay

16.2.1 Contractor shall not be charged for liquidated damages because of any delays in completion of Work which are not the fault of Contractor or its Subcontractors, including acts of God as defined in Public Contract Code section 7105, acts of enemy, epidemics, and quarantine restrictions. Contractor shall, within five (5) calendar days of beginning of any delay, notify District in writing of causes of delay including documentation and facts explaining the delay and the direct correlation between the cause and effect. District shall review the facts and extent of any delay and shall grant extension(s) of time for completing Work when, in its judgment, the findings of fact justify an extension. Extension(s) of time shall apply only to that portion of Work affected by delay, and shall not apply to other portions of Work not so affected. An extension of time may only be granted if Contractor has timely submitted the Construction Schedule as required herein.

16.2.2 Contractor shall notify the District pursuant to the claims provisions in these General Conditions of any anticipated delay and its cause. Following submission of a claim, the District may determine whether the delay is to be considered avoidable or unavoidable, how long it continues, and to what extent the prosecution and completion of the Work might be delayed thereby.

16.2.3 In the event the Contractor requests an extension of Contract Time for unavoidable delay, such request shall be submitted in accordance with the provisions in the Contract Documents governing changes in Work. When requesting time, requests must be submitted with full justification and documentation. If the Contractor fails to submit justification, it waives its right to a time extension at a later date. Such justification must be based on the official Construction Schedule as updated at the time of occurrence of the delay or execution of Work related to any changes to the Scope of Work. Any claim for delay must include the following information as support, without limitation:

16.2.3.1 The duration of the activity relating to the changes in the Work and the resources (manpower, equipment, material, etc.) required to perform the activities within the stated duration.

16.2.3.2 Specific logical ties to the Contract Schedule for the proposed changes and/or delay showing the activity/activities in the Construction Schedule that are affected by the change and/or delay. In particular, Contractor must show an actual impact to the schedule, after making a good faith effort to mitigate the delay by rescheduling the work, by providing an analysis of the schedule ("Time Impact Analysis"). Such Time Impact Analysis shall describe in detail the cause and effect of the delay and the impact on the critical dates in the Project schedule. (A portion of any delay of seven (7) days or more must be provided.)

16.2.3.3 A recovery schedule must be submitted within twenty (20) calendar days of written notification to the District of causes of delay.

16.3 No Additional Compensation for Delays Within Contractor's Control

16.3.1 Contractor is aware that governmental agencies, including, without limitation, the Division of the State Architect, the Department of General Services, gas companies, electrical utility companies, water districts, and other agencies may have to approve Contractor-prepared drawings or approve a proposed installation. Accordingly, Contractor shall include in its bid, time for possible review of its drawings and for reasonable delays and damages that may be caused by such agencies. Thus, Contractor is not entitled to make a claim for damages or delays arising from the review of Contractor's drawings.

16.3.2 Contractor shall only be entitled to compensation for delay when all of the following conditions are met:

16.3.2.1 The District is responsible for the delay;

16.3.2.2 The delay is unreasonable under the circumstances involved;

16.3.2.3 The delay was not within the contemplation of the District and Contractor;

16.3.2.4 The delay could not have been avoided or mitigated by Contractor's reasonable diligence; and

16.3.2.5 Contractor timely complies with the claims procedure of the Contract Documents.

16.4 Float or Slack in the Schedule

Float or slack is the amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any of the activities in the schedule. Float or slack is not for the exclusive use of or benefit of either the District or the Contractor, but its use shall be determined solely by the District.

17. CHANGES IN THE WORK**17.1 No Changes Without Authorization**

17.1.1 There shall be no change whatsoever in the Drawings, Specifications, or in the Work without an executed Change Order or a written Construction Change Directive authorized by the District as herein provided. District shall not be liable for the cost of any extra work or any substitutions, changes, additions, omissions, or deviations from the Drawings and Specifications unless the District's governing board has authorized the same and the cost thereof has been approved in writing by Change Order or Construction Change Directive in advance of the changed Work being performed. No extension of time for performance of the Work shall be allowed hereunder unless claim for such extension is made at the time changes in the Work are ordered, and such time duly adjusted and approved in writing in the Change Order or Construction Change Directive. Contractor shall be responsible for any costs incurred by the District for professional services and DSA fees and/or delay to the Project Schedule, if any, for DSA to review any request for changes to the DSA approved plans and specifications for the convenience of the Contractor and/or to accommodate the Contractor's means and methods. The provisions of the Contract Documents shall apply to all such changes, additions, and omissions with the same effect as if originally embodied in the Drawings and Specifications.

17.1.2 Contractor shall perform immediately all work that has been authorized by a fully executed Change Order or Construction Change Directive. Contractor shall be fully responsible for any and all delays and/or expenses caused by Contractor's failure to expeditiously perform this Work.

17.1.3 Should any Change Order result in an increase in the Contract Price or extend the Contract Time, the cost of or length of extension in that Change Order shall be agreed to, in writing, by the District in advance of the Work by Contractor, and shall be subject to the monetary limitations set forth in Public Contract Code section 20118.4. In the event that Contractor proceeds with any change in Work without a Change Order executed by the District or Construction Change Directive, Contractor waives any claim of additional compensation or time for that additional work. Under no circumstances shall Contractor be entitled to any claim of additional compensation or time not expressly requested by Contractor in a Proposed Change Order or approved by District in an executed Change Order.

17.1.4 A Change Order or Construction Change Directive will become effective when approved by the Board, notwithstanding that Contractor has not signed it. A Change Order or Construction Change Directive will become effective without Contractor's signature provided District indicates it as a "Unilateral Change Order". Any dispute as to the adjustment in the Contract Price or Contract Time, if any, of the Unilateral Change Order shall be resolved pursuant to the Payment and Claims and Disputes provisions herein.

17.1.5 Contractor understands, acknowledges, and agrees that the reason for District authorization is so that District may have an opportunity to analyze the Work and decide whether the District shall proceed with the Change Order or alter the Project so that a change in Work becomes unnecessary.

17.2 Architect Authority

The Architect will have authority to order minor changes in the Work not involving any adjustment in the Contract Price, or an extension of the Contract Time, or a change that is inconsistent with the intent of the Contract Documents. These changes shall be effected by written Change Order, Construction Change Directive, by Architect's response(s) to RFI(s), or by Architect's Supplemental Instructions ("ASI").

17.3 Change Orders

17.3.1 A Change Order is a written instrument prepared and issued by the District and/or the Architect and signed by the District (as authorized by the District's Governing Board), the Contractor, the Architect, and approved by the Project Inspector (if necessary) and DSA (if necessary), stating their agreement regarding all of the following:

17.3.1.1 A description of a change in the Work;

17.3.1.2 The amount of the adjustment in the Contract Price, if any; and

17.3.1.3 The extent of the adjustment in the Contract Time, if any.

17.4 Construction Change Directives

17.4.1 A Construction Change Directive is a written order prepared and issued by the District, the Construction Manager, and/or the Architect and signed by the District and the Architect, directing a change in the Work. The District may, as provided by law, by Construction Change Directive and without invalidating the Contract, order changes in the Work consisting of additions, deletions, or other revisions. The adjustment to the Contract Price or Time, if any, is subject to the provisions of this section regarding Changes in the Work. If all or a portion of the Project is being funded by funds requiring approval by the State Allocation Board ("SAB"), these revisions may be subject to compensation once approval of same is received and funded by the SAB, and funds are released by the Office of Public School Construction ("OPSC"). Any dispute as to the adjustment in the Contract Price, if any, of the Construction Change Directive or timing of payment shall be resolved pursuant to the Payment and Claims and Disputes provisions herein.

17.4.2 The District may issue a Construction Change Directive in the absence of agreement on the terms of a Change Order.

17.5 Force Account Directives

17.5.1 When work, for which a definite price has not been agreed upon in advance, is to be paid for on a force account basis, all direct costs necessarily incurred and paid by the Contractor for labor, material, and equipment used in the performance of that Work, shall be subject to the approval of the District and compensation will be determined as set forth herein.

17.5.2 The District will issue a Force Account Directive to proceed with the Work on a force account basis, and a not-to-exceed budget will be established by the District.

17.5.3 All requirements regarding direct cost for labor, labor burden, material, equipment, and markups on direct costs for overhead and profit described in this section shall apply to Force Account Directives. However, the District will only pay for actual costs verified in the field by the District or its authorized representative(s) on a daily basis.

17.5.4 The Contractor shall be responsible for all cost related to the administration of Force Account Directive. The markup for overhead and profit for Contractor modifications shall be full compensation to the Contractor to administer Force Account Directive, and Contractor shall not be entitled to separately recover additional amounts for overhead and/or profit.

17.5.5 The Contractor shall notify the District or its authorized representative(s) at least twenty-four (24) hours prior to proceeding with any of the force account work. Furthermore, the Contractor shall notify the District when it has consumed eighty percent (80%) of the budget, and shall not exceed the budget unless specifically authorized in writing by the District. The Contractor will not be compensated for force account work in the event that the Contractor fails to timely notify the District regarding the commencement of force account work, or exceeding the force account budget.

17.5.6 The Contractor shall diligently proceed with the work, and on a daily basis, submit a daily force account report on a form supplied by the District no later than 5:00 p.m. each day. The report shall contain a detailed itemization of the daily labor, material, and equipment used on the force account work only. The names of the individuals performing the force account work shall be included on the daily force account reports. The type and model of equipment shall be identified and listed. The District will review the information contained in the reports, and sign the reports no later than the next work day, and return a copy of the report to the Contractor for their records. The District will not sign, nor will the Contractor receive compensation for work the District cannot verify. The Contractor will provide a weekly force account summary indicating the status of each Force Account Directive in terms of percent complete of the not-to-exceed budget and the estimated percent complete of the work.

17.5.7 In the event the Contractor and the District reach a written agreement on a set cost for the work while the work is proceeding based on a Force Account Directive, the Contractor's signed daily force account reports shall be discontinued and all previously signed reports shall be invalid.

17.6 Price Request

17.6.1 Definition of Price Request

A Price Request ("PR") is a written request prepared by the Architect requesting the Contractor to submit to the District and the Architect an estimate of the effect of a proposed change in the Work on the Contract Price and the Contract Time.

17.6.2 Scope of Price Request

A Price Request shall contain adequate information, including any necessary Drawings and Specifications, to enable Contractor to provide the cost breakdowns

required herein. The Contractor shall not be entitled to any additional compensation for preparing a response to a Price Request, whether ultimately accepted or not.

17.7 Proposed Change Order

17.7.1 Definition of Proposed Change Order

A Proposed Change Order ("PCO") is a written request prepared by the Contractor requesting that the District and the Architect issue a Change Order based upon a proposed change to the Work.

17.7.2 Changes in Contract Price

A PCO shall include breakdowns and backup documentation pursuant to the revisions herein and sufficient, in the District's judgment, to validate any change in Contract Price. In no case shall Contractor or any of its Subcontractors be permitted to reserve rights for additional compensation for Change Order Work.

17.7.3 Changes in Time

A PCO shall also include any changes in time required to complete the Project. Any additional time requested shall not be the number of days to make the proposed change, but must be based upon the impact to the Construction Schedule as defined in the Contract Documents. The Contractor shall justify the proposed change in time by submittal of a schedule analysis that accurately shows the impact of the change on the critical path of the Construction Schedule ("Time Impact Analysis"). If Contractor fails to request a time extension in a PCO, including the Time Impact Analysis then the Contractor is thereafter precluded from requesting, and waives any right to request, additional time and/or claim a delay. In no case shall Contractor or any of its Subcontractors be permitted to reserve rights for additional time for Change Order Work. A PCO that leaves the amount of time requested blank, or states that such time requested is "to be determined", is not permitted and shall also constitute a waiver of any right to request additional time and/or claim a delay.

17.7.4 Unknown and/or Unforeseen Conditions

If there is an Allowance, then Contractor must submit a Request for Allowance Expenditure Directive, including supporting documentation as described below, to receive authorization for the release of funds from the Allowance. Allowance Expenditure Directives shall be based on Contractor's costs, without overhead and profit, for products, delivery, installation, labor, insurance, payroll, taxes, bonding and equipment rental will be included in Allowance Expenditure Directive authorizing expenditure of funds from this Allowance. No overhead and profit shall be added to the Allowance Expenditure Directive. If cost of the unforeseen condition(s) exceed the Allowance, Contractor must submit a PCO for amounts in excess of the Allowance requesting an increase in Contract Price and/or Contract Time that is based at least partially on Contractor's assertion that Contractor has encountered unknown and/or unforeseen condition(s) on the Project, then Contractor shall base the PCO on provable information that, beyond a reasonable doubt and to the District's satisfaction, demonstrates that the unknown and/or unforeseen condition(s) were actually unknown and/or unforeseen and that the condition(s) were reasonably unknown and/or unforeseen. If not, the District shall deny the PCO as

unsubstantiated, and the Contractor shall complete the Project without any increase in Contract Price and/or Contract Time based on that PCO.

17.7.5 Time to Submit Proposed Change Order

Contractor shall submit its PCO within five (5) working days of the date Contractor discovers, or reasonably should have discovered, the circumstances giving rise to the PCO, unless additional time to submit a PCO is granted in writing by the District. Time is of the essence in Contractor's submission of PCOs so that the District can promptly investigate the basis for the PCO. Accordingly, if Contractor fails to submit its PCO within this timeframe, Contractor waives, releases, and discharges any right to assert or claim any entitlement to an adjustment of the Contract Price and/or Time based on circumstances giving rise to the PCO

17.7.6 Proposed Change Order Certification

In submitting a PCO, Contractor certifies and affirms that the cost and/or time request is submitted in good faith, that the cost and/or time request is accurate and in accordance with the provisions of the Contract Documents, and the Contractor submits the cost and/or request for extension of time recognizing the significant civil penalties and treble damages which follow from making a false claim or presenting a false claim under Government Code section 12650 et seq.

It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

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17.8 Format for Proposed Change Order

17.8.1 The following format shall be used as applicable by the District and the Contractor (e.g. Change Orders, PCO’s) to communicate proposed additions and deductions to the Contract, supported by attached documentation. Any spaces left blank will be deemed no change to cost or time.

	<u>WORK PERFORMED OTHER THAN BY CONTRACTOR</u>	<u>ADD</u>	<u>DEDUCT</u>
(a)	<u>Material</u> (attach suppliers’ invoice or itemized quantity and unit cost plus sales tax)		
(b)	<u>Add Labor</u> (attach itemized hours and rates, fully encumbered)		
(c)	<u>Add Equipment</u> (attach suppliers’ invoice)		
(d)	<u>Subtotal</u>		
(e)	<u>Add overhead and profit for any and all tiers of Subcontractor</u> , the total not to exceed ten percent (10%) of Item (d)		
(f)	<u>Subtotal</u>		
(g)	<u>Add Overhead and Profit for Contractor</u> , not to exceed five percent (5%) of Item (f)		
(h)	<u>Subtotal</u>		
(i)	<u>Add Bond and Insurance</u> , not to exceed one and a half percent (1.5%) of Item (h)		
(j)	<u>TOTAL</u>		
(k)	<u>Time</u> (zero unless indicated; “TBD” not permitted)	_____	Calendar Days

	<u>WORK PERFORMED BY CONTRACTOR</u>	<u>ADD</u>	<u>DEDUCT</u>
(l)	<u>Material</u> (attach itemized quantity and unit cost plus sales tax)		
(m)	<u>Add Labor</u> (attach itemized hours and rates, fully encumbered)		
(n)	<u>Add Equipment</u> (attach suppliers’ invoice)		
(o)	<u>Subtotal</u>		
(p)	<u>Add Overhead and Profit for Contractor</u> , not to exceed fifteen percent (15%) of Item (d)		
(q)	<u>Subtotal</u>		
(r)	<u>Add Bond and Insurance</u> , not to exceed one and a half percent (1.5%) of Item (f)		
(s)	<u>TOTAL</u>		
(t)	<u>Time</u> (zero unless indicated; “TBD” not permitted)	_____	Calendar Days

17.8.2 Labor. Contractor shall be compensated for the costs of labor actually and directly utilized in the performance of the Work. Such labor costs shall be the actual cost, not to exceed prevailing wage rates in the locality of the Site and shall be in the labor classification(s) necessary for the performance of the Work, plus employer payments of payroll taxes and insurance, health and welfare, pension,

vacation, apprenticeship funds, and other direct costs resulting from Federal, State, or local laws. Labor costs shall exclude costs incurred by the Contractor in preparing estimate(s) of the costs of the change in the Work, in the maintenance of records relating to the costs of the change in the Work, coordination and assembly of materials and information relating to the change in the Work or performance thereof, or the supervision and other overhead and general conditions costs associated with the change in the Work or performance thereof, including but not limited to the cost for the job superintendent.

17.8.3 Materials. Contractor shall be compensated for the costs of materials necessarily and actually used or consumed in connection with the performance of the change in the Work. Costs of materials may include reasonable costs of transportation from a source closest to the Site of the Work and delivery to the Site. If discounts by material suppliers are available for materials necessarily used in the performance of the change in the Work, they shall be credited to the District. If materials necessarily used in the performance of the change in the Work are obtained from a supplier or source owned in whole or in part by the Contractor, compensation therefor shall not exceed the current wholesale price for such materials. If, in the reasonable opinion of the District, the costs asserted by the Contractor for materials in connection with any change in the Work are excessive, or if the Contractor fails to provide satisfactory evidence of the actual costs of such materials from its supplier or vendor of the same, the costs of such materials and the District's obligation to pay for the same shall be limited to the then lowest wholesale price at which similar materials are available in the quantities required to perform the change in the Work. The District may elect to furnish materials for the change in the Work, in which event the Contractor shall not be compensated for the costs of furnishing such materials or any mark-up thereon.

17.8.4 Equipment. As a precondition for the District's duty to pay for Equipment rental or loading and transportation, Contractor shall provide satisfactory evidence of the actual costs of Equipment from the supplier, vendor or rental agency of same. Contractor shall be compensated for the actual cost of the necessary and direct use of Equipment in the performance of the change in the Work. Use of such Equipment in the performance of the change in the Work shall be compensated in increments of fifteen (15) minutes. Rental time for Equipment moved by its own power shall include time required to move such Equipment to the site of the Work from the nearest available rental source of the same. If Equipment is not moved to the Site by its own power, Contractor will be compensated for the loading and transportation costs in lieu of rental time. The foregoing notwithstanding, neither moving time or loading and transportation time shall be allowed if the Equipment is used for performance of any portion of the Work other than the change in the Work. Unless prior approval in writing is obtained by the Contractor from the Architect, the Project Inspector and the District, no costs or compensation shall be allowed for time while Construction Equipment is inoperative, idle or on standby, for any reason. Contractor shall not be entitled to an allowance or any other compensation for Equipment or tools used in the performance of change in the Work where such Equipment or tools have a replacement value of \$500.00 or less. Equipment costs claimed by the Contractor in connection with the performance of any Work shall not exceed rental rates established by distributors or construction equipment rental agencies in the locality of the Site; any costs asserted which exceed such rental rates shall not be allowed or paid. Unless otherwise specifically approved in writing by the Architect, the Project Inspector and the District, the allowable rate for the use of

Equipment in connection with the Work shall constitute full compensation to the Contractor for the cost of rental, fuel, power, oil, lubrication, supplies, necessary attachments, repairs or maintenance of any kind, depreciation, storage, insurance, labor (exclusive of labor costs of the Equipment operator), and any and all other costs incurred by the Contractor incidental to the use of such Equipment.

17.8.5 Overhead and Profit. The phrase "Overhead and Profit" shall include field and office supervisors and assistants, watchperson, use of small tools, consumable, insurance other than construction bonds and insurance required herein, general conditions costs and home office expenses.

17.9 Change Order Certification

17.9.1 All Change Orders and PCOs include the following certification by the Contractor, either in the form specifically or incorporated by this reference:

17.9.1.1 The undersigned Contractor approves the foregoing as to the changes, if any, to the Contract Price specified for each item, and as to the extension of time allowed, if any, for completion of the entire Work as stated herein, and agrees to furnish all labor, materials, and service, and perform all work necessary to complete any additional work specified for the consideration stated herein. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 et seq. It is understood that the changes herein to the Contract shall only be effective when approved by the governing board of the District.

17.9.1.2 It is expressly understood that the value of the extra Work or changes expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor is not entitled to separately recover amounts for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

17.9.2 Accord and Satisfaction: Contractor's execution of any Change Order shall constitute a full accord and satisfaction, and release, of all Contractor (and if applicable, Subcontractor) claims for additional time, money or other relief arising from or relating to the subject matter of the change including, without limitation, impacts of all types, cumulative impacts, inefficiency, overtime, delay and any other type of claim.

17.10 Determination of Change Order Cost

17.10.1 The amount of the increase or decrease in the Contract Price from a Change Order, if any, shall be determined in one or more of the following ways as applicable to a specific situation and at the District's discretion:

17.10.1.1 District acceptance of a PCO;

17.10.1.2 By unit prices contained in Contractor's original bid;

17.10.1.3 By agreement between District and Contractor.

17.11 Deductive Change Orders

All deductive Change Order(s) must be prepared pursuant to the provisions herein. Where a portion of the Work is deleted from the Contract, the reasonable value of the deducted work less the value of work performed shall be considered the appropriate deduction. The value submitted on the Schedule of Values shall be used to calculate the credit amount unless the bid documentation is being held in escrow as part of the Contract Documents. Unit Prices, if any, may be used in District's discretion in calculating reasonable value. If Contractor offers a proposed amount for a deductive Change Order(s), Contractor shall include a minimum of five percent (5%) total profit and overhead to be deducted with the amount of the work of the Change Order(s). If Subcontractor work is involved, Subcontractors shall also include a minimum of five percent (5%) profit and overhead to be deducted with the amount of its deducted work. Any deviation from this provision shall not be allowed.

17.12 Addition or Deletion of Alternate Bid Item(s)

If the Bid Form and Proposal includes proposal(s) for Alternate Bid Item(s), during Contractor's performance of the Work, the District may elect to add or delete any such Alternate Bid Item(s) if not included in the Contract at the time of award. If the District elects to add or delete Alternate Bid Item(s) after Contract award, the cost or credit for such Alternate Bid Item(s) shall be as set forth in the Bid Form and Proposal unless the parties agree to a different price and the Contract Time shall be adjusted by the number of days allocated in the Contract Documents. If days are not allocated in the Contract Documents, the Contract Time shall be equitably adjusted.

17.13 Discounts, Rebates, and Refunds

For purposes of determining the cost, if any, of any change, addition, or omission to the Work hereunder, all trade discounts, rebates, refunds, and all returns from the sale of surplus materials and equipment shall accrue and be credited to the Contractor, and the Contractor shall make provisions so that such discounts, rebates, refunds, and returns may be secured, and the amount thereof shall be allowed as a reduction of the Contractor's cost in determining the actual cost of construction for purposes of any change, addition, or omission in the Work as provided herein.

17.14 Accounting Records

With respect to portions of the Work performed by Change Orders and Construction Change Directives, the Contractor shall keep and maintain cost-accounting records satisfactory to the District, including, without limitation, Job Cost Reports as provided in these General Conditions, which shall be available to the District on the same terms as any other books and records the Contractor is required to maintain under the Contract Documents. Such records shall include without limitation hourly records for Labor and Equipment and itemized records of materials and Equipment used that day in connection with the performance of any Work. All records maintained hereunder shall be subject to inspection, review and/or reproduction by the District, the Architect or the Project Inspector upon request. In the event that the Contractor fails or refuses, for any reason, to maintain or make available for inspection, review and/or reproduction such

records, the District's reasonable good faith determination of the extent of adjustment to the Contract Price shall be final, conclusive, dispositive and binding upon Contractor.

17.15 Notice Required

If the Contractor desires to make a claim for an increase in the Contract Price, or any extension in the Contract Time for completion, it shall notify the District pursuant to the provisions herein, including the Article on Claims and Disputes. No claim shall be considered unless made in accordance with this subparagraph. Contractor shall proceed to execute the Work even though the adjustment may not have been agreed upon. Any change in the Contract Price or extension of the Contract Time resulting from such claim shall be authorized by a Change Order.

17.16 Applicability to Subcontractors

Any requirements under this Article shall be equally applicable to Change Orders or Construction Change Directives issued to Subcontractors by the Contractor to the extent as required by the Contract Documents.

17.17 Alteration to Change Order Language

Contractor shall not alter Change Orders or reserve time in Change Orders. Change Orders altered in violation of this provision, if in conflict with the terms set forth herein, shall be construed in accordance with the terms set forth herein. Contractor shall execute finalized Change Orders and proceed under the provisions herein with proper notice.

17.18 Failure of Contractor to Execute Change Order

Contractor shall be in default of the Contract if Contractor fails to execute a Change Order when the Contractor agrees with the addition and/or deletion of the Work in that Change Order.

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18. REQUEST FOR INFORMATION

18.1 Any Request for Information shall reference all applicable Contract Document(s), including Specification section(s), detail(s), page number(s), drawing number(s), and sheet number(s), etc. The Contractor shall make suggestions and interpretations of the issue raised by each Request for Information. A Request for Information cannot modify the Contract Price, Contract Time, or the Contract Documents. Upon request by the District, Contractor shall provide an electronic copy of the Request for Information in addition to the hard copy.

18.2 The Contractor shall be responsible for any costs incurred for professional services that District may deduct from any amounts owing to the Contractor, if a Request for Information requests an interpretation or decision of a matter where the information sought is equally available to the party making the request. District, at its sole discretion, shall deduct from and/or invoice Contractor for all the professional services arising herein.

19. PAYMENTS

19.1 Contract Price

The Contract Price is stated in the Agreement and, including authorized adjustments, is the total amount payable by the District to the Contractor for performance of the Work under the Contract Documents.

19.2 Applications for Progress Payments

19.2.1 Procedure for Applications for Progress Payments

19.2.1.1 Application for Progress Payment

19.2.1.1.1 Not before the fifth (5th) day of each calendar month during the progress of the Work, Contractor shall submit to the District and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be notarized, if required, and supported by the following or each portion thereof unless waived by the District in writing:

19.2.1.1.1.1 Contractor shall submit a separate Application for Payment for each Increment (Increment 1 and Increment 2).

19.2.1.1.1.2 Contractor is required to upload Applications for Payment into a designated Project Management Information System (PMIS) as required by the District.

19.2.1.1.1.3 The amount paid to the date of the Application to the Contractor, to all its Subcontractors, and all others furnishing labor, material, or equipment for its Contract;

19.2.1.1.1.4 The amount being requested under the Application for Payment by the Contractor on its own behalf and separately stating the

amount requested on behalf of each of the Subcontractors and all others furnishing labor, material, and equipment under the Contract;

19.2.1.1.1.5 The balance that will be due to each of such entities after said payment is made;

19.2.1.1.1.6 A certification that the As-Builts and annotated Specifications are current;

19.2.1.1.1.7 Itemized breakdown of work done for the purpose of requesting partial payment;

19.2.1.1.1.8 An updated and acceptable construction schedule in conformance with the provisions herein;

19.2.1.1.1.9 The additions to and subtractions from the Contract Price and Contract Time;

19.2.1.1.1.10 A total of the retentions held;

19.2.1.1.1.11 Material invoices, evidence of equipment purchases, rentals, and other support and details of cost as the District may require from time to time;

19.2.1.1.1.12 The percentage of completion of the Contractor's Work by line item;

19.2.1.1.1.13 Schedule of Values updated from the preceding Application for Payment;

19.2.1.1.1.14 A duly completed and executed conditional waiver and release upon progress payment compliant with Civil Code section 8132 from the Contractor and each subcontractor of any tier and supplier to be paid from the current progress payment;

19.2.1.1.1.15 A duly completed and executed unconditional waiver and release upon progress payment compliant with Civil Code section 8134 from the Contractor and each subcontractor of any tier and supplier that was paid from the previous progress payment(s); and

19.2.1.1.1.16 A certification by the Contractor of the following:

The Contractor warrants title to all Work performed as of the date of this payment application has been completed in accordance with the Contract Documents for the Project. The Contractor further warrants that all amounts have been paid for work which previous Certificates for Payment were issued and payments received and all Work performed as of the date of this payment application is free and clear of liens, claims, security interests, or encumbrances in favor of the Contractor, Subcontractors, material and equipment suppliers, workers, or other persons or entities making a claim by reason of having provided labor, materials, and equipment relating to the Work, except those of which the District has been informed. Submission of sums which have no basis in fact or which Contractor knows are false are at the sole risk of Contractor and may be a violation of the False Claims Act set forth under Government Code section 12650 et seq.

19.2.1.1.1.17 The Contractor shall be subject to the False Claims Act set forth in Government Code section 12650 et seq. for information provided with any Application for Progress Payment.

19.2.1.1.1.18 All remaining certified payroll records ("CPR(s)") for each journeyman, apprentice, worker, or other employee employed by the Contractor and/or each Subcontractor in connection with the Work for the period of the Application for Payment. As indicated herein, the District shall not make any payment to Contractor until:

19.2.1.1.1.18.1 Contractor and/or its Subcontractor(s) provide electronic CPRs weekly for all weeks any journeyman, apprentice, worker or other employee was employed in connection with the Work directly to the DIR, or within ten (10) days of any request by the District or the DIR, and

19.2.1.1.1.18.2 Any delay in Contractor and/or its Subcontractor(s) providing CPRs in a timely manner may directly delay the Contractor's payment.

19.2.1.1.2 Applications received after June 20th will not be paid until the second week of July and applications received after December 12th will not be paid until the first week of January.

19.2.2 Prerequisites for Progress Payments

19.2.2.1 First Payment Request: The following items, if applicable, must be completed before the District will accept and/or process the Contractor's first payment request:

19.2.2.1.1 Installation of the Project sign;

19.2.2.1.2 Installation of field office;

19.2.2.1.3 Installation of temporary facilities and fencing;

- 19.2.2.1.4** Schedule of Values;
- 19.2.2.1.5** Contractor's Construction Schedule;
- 19.2.2.1.6** Schedule of unit prices, if applicable;
- 19.2.2.1.7** Submittal Schedule;
- 19.2.2.1.8** Receipt by Architect of all submittals due as of the date of the payment application;
- 19.2.2.1.9** Copies of necessary permits;
- 19.2.2.1.10** Copies of authorizations and licenses from governing authorities;
- 19.2.2.1.11** Initial progress report;
- 19.2.2.1.12** Surveyor qualifications;
- 19.2.2.1.13** Written acceptance of District's survey of rough grading, if applicable;
- 19.2.2.1.14** List of all Subcontractors, with names, license numbers, telephone numbers, and Scope of Work;
- 19.2.2.1.15** All bonds and insurance endorsements; and
- 19.2.2.1.16** Resumes of Contractor's project manager, and if applicable, job site secretary, record documents recorder, and job site superintendent.

19.2.2.2 Second Payment Request: The District will not process the second payment request until and unless all submittals and Shop Drawings have been accepted for review by the Architect.

19.2.2.3 No Waiver of Criteria: Any payments made to Contractor where criteria set forth herein have not been met shall not constitute a waiver of said criteria by District. Instead, such payment shall be construed as a good faith effort by District to resolve differences so Contractor may pay its Subcontractors and suppliers. Contractor agrees that failure to submit such items may constitute a breach of contract by Contractor and may subject Contractor to termination.

19.3 Progress Payments

19.3.1 District's Approval of Application for Payment

19.3.1.1 Upon receipt of an Application for Payment, The District shall act in accordance with both of the following:

19.3.1.1.1 Each Application for Payment shall be reviewed by the District as soon as practicable after receipt for the purpose of determining that the Application for Payment is a proper Application for Payment.

19.3.1.1.2 Any Application for Payment determined not to be a proper Application for Payment suitable for payment shall be returned to the Contractor as soon as practicable, but not later than seven (7) days, after receipt. An Application for Payment returned pursuant to this paragraph shall be accompanied by a document setting forth in writing the reasons why the Application for Payment is not proper. The number of days available to the District to make a payment without incurring interest pursuant to this section shall be reduced by the number of days by which the District exceeds this seven-day return requirement.

19.3.1.1.3 An Application for Payment shall be considered properly executed if funds are available for payment of the Application for Payment, and payment is not delayed due to an audit inquiry by the financial officer of the District.

19.3.1.2 The District's review of the Contractor's Application for Payment will be based on the District's and the Architect's observations at the Site and the data comprising the Application for Payment that the Work has progressed to the point indicated and that, to the best of the District's and the Architect's knowledge, information, and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to:

19.3.1.2.1 Observation of the Work for general conformance with the Contract Documents,

19.3.1.2.2 Results of subsequent tests and inspections,

19.3.1.2.3 Minor deviations from the Contract Documents correctable prior to completion, and

19.3.1.2.4 Specific qualifications expressed by the Architect.

19.3.1.3 District's approval of the certified Application for Payment shall be based on Contractor complying with all requirements for a fully complete and valid certified Application for Payment.

19.3.2 Payments to Contractor

19.3.2.1 Within thirty (30) days after approval of the Application for Payment, Contractor shall be paid a sum equal to ninety-five percent (95%) of the value of the Work performed (as verified by Architect and Inspector and certified by Contractor) up to the last day of the previous month, less the aggregate of previous payments and amount to be withheld. The value of the Work completed shall be Contractor's best estimate. No inaccuracy or error in said estimate shall operate to release the Contractor, or any Surety upon any bond, from damages arising from such Work, or from the District's right to enforce each and every provision of this Contract, and the District shall have the right subsequently to correct any error made in any estimate for payment.

19.3.2.2 The Contractor shall not be entitled to have any payment requests processed, or be entitled to have any payment made for Work performed, so long

as any lawful or proper direction given by the District concerning the Work, or any portion thereof, remains incomplete.

19.3.2.3 If the District fails to make any progress payment within thirty (30) days after receipt of an undisputed and properly submitted Application for Payment from the Contractor, the District shall pay interest to the Contractor equivalent to the legal rate set forth in subdivision (a) of Section 685.010 of the Code of Civil Procedure.

19.3.3 No Waiver

No payment by District hereunder shall be interpreted so as to imply that District has inspected, approved, or accepted any part of the Work. Notwithstanding any payment, the District may enforce each and every provision of this Contract. The District may correct or require correction of any error subsequent to any payment.

19.4 Decisions to Withhold Payment

19.4.1 Reasons to Withhold Payment

The District may withhold payment in whole, or in part, to the extent reasonably necessary to protect the District if, in the District's opinion, the representations to the District required herein cannot be made. The District may withhold payment, in whole, or in part, to such extent as may be necessary to protect the District from loss because of, but not limited to any of the following:

19.4.1.1 Defective Work not remedied within **FORTY-EIGHT (48)** hours of written notice to Contractor.

19.4.1.2 Stop Payment Notices or other liens served upon the District as a result of the Contract. Contractor agrees that the District may withhold up to 125% of the amount claimed in the Stop Payment Notice to answer the claim and to provide for the District's reasonable cost of any litigation pursuant to the stop payment notice.

19.4.1.3 Liquidated damages assessed against the Contractor.

19.4.1.4 The cost of completion of the Contract if there exists a reasonable doubt that the Work can be completed for the unpaid balance of the Contract Price or by the completion date.

19.4.1.5 Damage to the District or other contractor(s).

19.4.1.6 Unsatisfactory prosecution of the Work by the Contractor.

19.4.1.7 Failure to store and properly secure materials.

19.4.1.8 Failure of the Contractor to submit, on a timely basis, proper, sufficient, and acceptable documentation required by the Contract Documents, including, without limitation, a Construction Schedule, Schedule of Submittals, Schedule of Values, Monthly Progress Schedules, Shop Drawings, Product Data

and samples, Proposed product lists, executed Change Orders, and/or verified reports.

19.4.1.9 Failure of the Contractor to maintain As-Builts.

19.4.1.10 Erroneous estimates by the Contractor of the value of the Work performed, or other false statements in an Application for Payment.

19.4.1.11 Unauthorized deviations from the Contract Documents.

19.4.1.12 Failure of the Contractor to prosecute the Work in a timely manner in compliance with the Construction Schedule, established progress schedules, and/or completion dates.

19.4.1.13 Failure to provide acceptable electronic certified payroll records, as required by the Labor Code, by these Contract Documents, or by written request; for each journeyman, apprentice, worker, or other employee employed by the Contractor and/or by each Subcontractor in connection with the Work for the period of the Application for Payment or if payroll records are delinquent or inadequate.

19.4.1.14 Failure to properly pay prevailing wages as required in Labor Code section 1720 et seq., failure to comply with any other Labor Code requirements, and/or failure to comply with labor compliance monitoring and enforcement by the DIR.

19.4.1.15 Allowing an unregistered subcontractor, as described in Labor Code section 1725.5, to engage in the performance of any work under this Contract.

19.4.1.16 Failure to comply with any applicable federal statutes and regulations regarding minimum wages, withholding, payrolls and basic records, apprentice and trainee employment requirements, equal employment opportunity requirements, Copeland Act requirements, Davis-Bacon Act and related requirements, Contract Work Hours and Safety Standards Act requirements, if applicable.

19.4.1.17 Failure to properly maintain or clean up the Site.

19.4.1.18 Failure to timely indemnify, defend, or hold harmless the District.

19.4.1.19 Any payments due to the District, including but not limited to payments for failed tests, utilities changes, or permits.

19.4.1.20 Failure to pay Subcontractor(s) or supplier(s) as required by law and by the Contract Documents.

19.4.1.21 Failure to pay any royalty, license or similar fees.

19.4.1.22 Contractor is otherwise in breach, default, or in substantial violation of any provision of this Contract.

19.4.1.23 Failure to perform any implementation and/or monitoring required by any SWPPP for the Project and/or the imposition of any penalties or fines therefore whether imposed on the District or Contractor.

19.4.2 Reallocation of Withheld Amounts

19.4.2.1 District may, in its discretion, apply any withheld amount to pay outstanding claims or obligations as defined herein. In so doing, District shall make such payments on behalf of Contractor. If any payment is so made by District, then that amount shall be considered a payment made under Contract by District to Contractor and District shall not be liable to Contractor for any payment made in good faith. These payments may be made without prior judicial determination of claim or obligation. District will render Contractor an accounting of funds disbursed on behalf of Contractor.

19.4.2.2 If Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents or fails to perform any provision thereof, District may, after **FORTY-EIGHT (48)** hours' written notice to the Contractor and, without prejudice to any other remedy, make good such deficiencies. The District shall adjust the total Contract Price by reducing the amount thereof by the cost of making good such deficiencies. If District deems it inexpedient to correct Work that is damaged, defective, or not done in accordance with Contract provisions, an equitable reduction in the Contract Price (of at least one hundred fifty percent (150%) of the estimated reasonable value of the nonconforming Work) shall be made therefor.

19.4.3 Payment After Cure

When Contractor removes the grounds for declining approval, payment shall be made for amounts withheld because of them. No interest shall be paid on any retainage or amounts withheld due to the failure of the Contractor to perform in accordance with the terms and conditions of the Contract Documents.

19.5 Subcontractor Payments

19.5.1 Payments to Subcontractors

No later than seven (7) days after receipt, or pursuant to Business and Professions Code section 7108.5 and Public Contract Code section 7107, the Contractor shall pay to each Subcontractor, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to its Sub-subcontractors in a similar manner.

19.5.2 No Obligation of District for Subcontractor Payment

The District shall have no obligation to pay, or to see to the payment of, money to a Subcontractor except as may otherwise be required by law.

19.5.3 Joint Checks

District shall have the right in its sole discretion, if necessary for the protection of the District, to issue joint checks made payable to the Contractor and Subcontractors and/or material or equipment suppliers. The joint check payees shall be responsible for the allocation and disbursement of funds included as part of any such joint payment. In no event shall any joint check payment be construed to create any contract between the District and a Subcontractor of any tier, or a material or equipment supplier, any obligation from the District to such Subcontractor or a material or equipment supplier, or rights in such Subcontractor or a material or equipment supplier against the District.

20. COMPLETION OF THE WORK

20.1 Completion

20.1.1 District will accept completion of Contract and have the Notice of Completion recorded when the entire Work shall have been completed to the satisfaction of District.

20.1.2 The Work may only be accepted as complete by action of the governing board of the District.

20.1.3 District, at its sole option, may accept completion of Contract and have the Notice of Completion recorded when the entire Work shall have been completed to the satisfaction of District, except for minor corrective items, as distinguished from incomplete items. If Contractor fails to complete all minor corrective items within fifteen (15) days after the date of the District's acceptance of completion, District shall withhold from the final payment one hundred fifty percent (150%) of an estimate of the amount sufficient to complete the corrective items, as determined by District, until the item(s) are completed.

20.1.4 At the end of the 15-day period, if there are any items remaining to be corrected, District may elect to proceed as provided herein related to adjustments to Contract Price, and/or District's right to perform the Work of the Contractor.

20.2 Close-Out/Certification Procedures

20.2.1 Punch List

The Contractor shall notify the Architect when Contractor considers the Work complete. Upon notification, Architect will prepare a list of minor items to be completed or corrected ("Punch List"). The Contractor and/or its Subcontractors shall proceed promptly to complete and correct items on the Punch List. Failure to

include an item on Punch List does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

20.2.2 Close-Out/Certification Requirements

20.2.2.1 Utility Connections

Buildings shall be connected to water, gas, sewer, and electric services, complete and ready for use. Service connections shall be made and existing services reconnected.

20.2.2.2 Record Drawings and Record Specifications

20.2.2.2.1 Contractor shall provide exact Record Drawings of the Work ("As-Builts") and Record Specifications upon completion of the Project and as a condition precedent to approval of final payment.

20.2.2.2.2 Contractor shall obtain the Inspector's approval of the corrected prints and employ a competent draftsman to transfer the Record Drawings information to the most current version of AutoCAD that is, at that time, currently utilized for plan check submission by either the District, the Architect, OPSC, and/or DSA, and print a complete set of transparent sepias. When completed, Contractor shall deliver corrected sepias and diskette/CD/other

20.2.2.2.3 Contractor is liable and responsible for any and all inaccuracies in the Record Drawings and Record Specifications, even if inaccuracies become evident at a future date.

20.2.2.3 Maintenance Manuals: Contractor shall prepare all operation and maintenance manuals and date as indicated in the Specifications.

20.2.2.4 Source Programming: Contractor shall provide all source programming for all items in the Project.

20.2.2.5 Verified Reports: Contractor shall completely and accurately fill out and file forms DSA 6-C or DSA 152 (or current form), as appropriate. Refer to section 4-336 and section 4-343 of Part 1, Title 24 of the California Code of Regulations.

20.3 Final Inspection

20.3.1 Contractor shall comply with Punch List procedures as provided herein, and maintain the presence of a Project Superintendent and Project Manager until the Punch List is complete to ensure proper and timely completion of the Punch List. Under no circumstances shall Contractor demobilize its forces prior to completion of the Punch List without District's prior written approval. Upon receipt of Contractor's written notice that all of the Punch List items have been fully completed and the Work is ready for final inspection and District acceptance, Architect and Project Inspector will inspect the Work and shall submit to Contractor and District a final inspection report noting the Work, if any, required in order to complete in

accordance with the Contract Documents. Absent unusual circumstances, this report shall consist of the Punch List items not yet satisfactorily completed.

20.3.2 Upon Contractor's completion of all items on the Punch List and any other uncompleted portions of the Work, the Contractor shall notify the District and Architect, who shall again inspect such Work. If the Architect finds the Work complete and acceptable under the Contract Documents, the Architect will notify Contractor, who shall then jointly submit to the Architect and the District its final Application for Payment.

20.3.3 Final Inspection Requirements

20.3.3.1 Before calling for final inspection, Contractor shall determine that the following have been performed:

- 20.3.3.1.1** The Work has been completed.
- 20.3.3.1.2** All life safety items are completed and in working order.
- 20.3.3.1.3** Mechanical and electrical Work are complete and tested, fixtures are in place, connected, and ready for tryout.
- 20.3.3.1.4** Electrical circuits scheduled in panels and disconnect switches labeled.
- 20.3.3.1.5** Painting and special finishes complete.
- 20.3.3.1.6** Doors complete with hardware, cleaned of protective film, relieved of sticking or binding, and in working order.
- 20.3.3.1.7** Tops and bottoms of doors sealed.
- 20.3.3.1.8** Floors waxed and polished as specified.
- 20.3.3.1.9** Broken glass replaced and glass cleaned.
- 20.3.3.1.10** Grounds cleared of Contractor's equipment, raked clean of debris, and trash removed from Site.
- 20.3.3.1.11** Work cleaned, free of stains, scratches, and other foreign matter, and damaged and broken material replaced.
- 20.3.3.1.12** Finished and decorative work shall have marks, dirt, and superfluous labels removed.
- 20.3.3.1.13** Final cleanup, as provided herein.

20.4 Costs of Multiple Inspections

More than two (2) requests of the District to make a final inspection shall be considered an additional service of District, Architect, Construction Manager, and/or Project

Inspector, and all subsequent costs will be invoiced to Contractor and if funds are available, withheld from remaining payments.

20.5 Partial Occupancy or Use Prior to Completion

20.5.1 District's Rights to Occupancy

The District may occupy or use any completed or partially completed portion of the Work at any stage, and such occupancy shall not constitute the District's Final Acceptance of any part of the Work. Neither the District's Final Acceptance, the making of Final Payment, any provision in Contract Documents, nor the use or occupancy of the Work, in whole or in part, by District shall constitute acceptance of Work not in accordance with the Contract Documents nor relieve the Contractor or the Contractor's Performance Bond Surety from liability with respect to any warranties or responsibility for faulty or defective Work or materials, equipment and workmanship incorporated therein. In the event that the District occupies or uses any completed or partially completed portion of the Work, the Contractor shall remain responsible for payments, security, maintenance, heat, utilities, damage to the Work, insurance, the period for correction of the Work, and the commencement of warranties required by the Contract Documents unless the Contractor requests in writing, and the District agrees, to otherwise divide those responsibilities. Any dispute as to responsibilities shall be resolved pursuant to the Claims and Disputes provisions herein, with the added provision that during the dispute process, the District shall have the right to occupy or use any portion of the Work that it needs or desires to use.

20.5.2 Inspection Prior to Occupancy or Use

Immediately prior to partial occupancy or use, the District, the Contractor, and the Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

20.5.3 No Waiver

Unless otherwise agreed upon, partial or entire occupancy or use of a portion or portions of the Work shall not constitute beneficial occupancy or District's acceptance of the Work not complying with the requirements of the Contract Documents.

21. FINAL PAYMENT AND RETENTION

21.1 Final Payment

Upon receipt and approval of a valid and final Application for Payment, the Architect will issue a final Certificate of Payment. The District shall thereupon jointly inspect the Work and either accept the Work as complete or notify the Architect and the Contractor in writing of reasons why the Work is not complete. Upon District's acceptance of the Work of the Contractor as fully complete by the Governing Board of the District (that, absent unusual circumstances, will occur when the Punch List items have been satisfactorily completed), the District shall record a Notice of Completion with the County Recorder, and the Contractor shall, upon receipt of final payment from the District, pay the amount due Subcontractors.

21.2 Prerequisites for Final Payment

The following conditions must be fulfilled prior to Final Payment:

21.2.1 A full release of all Stop Payment Notices served in connection with the Work shall be submitted by Contractor.

21.2.2 A duly completed and executed conditional waiver and release upon final payment compliant with Civil Code section 8136, from the Contractor and each subcontractor of any tier and supplier to be paid from the final payment.

21.2.3 A duly completed and executed unconditional waiver and release upon progress payment compliant with Civil Code section 8134, from the Contractor and each subcontractor of any tier and supplier that was paid from the previous progress payments.

21.2.4 A duly completed and executed Document 00 65 19.26, "AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS" from the Contractor.

21.2.5 The Contractor shall have made all corrections to the Work that are required to remedy any defects therein, to obtain compliance with the Contract Documents or any requirements of applicable codes and ordinances, or to fulfill any of the orders or directions of District required under the Contract Documents.

21.2.6 Each Subcontractor shall have delivered to the Contractor all written guarantees, warranties, applications, and bonds required by the Contract Documents for its portion of the Work.

21.2.7 Contractor must have completed all requirements set forth under "Close-Out/Certification Procedures," including, without limitation, submission of an approved set of complete Record Drawings.

21.2.8 Architect shall have issued its written approval that final payment can be made.

21.2.9 The Contractor shall have delivered to the District all manuals and materials required by the Contract Documents, which must be approved by the District.

21.2.10 The Contractor shall have completed final clean-up as provided herein.

21.3 Retention

21.3.1 The retention, less any amounts disputed by the District or that the District has the right to withhold pursuant to provisions herein, shall be paid:

21.3.1.1 After approval by the Architect of the Application and Certificate of Payment,

21.3.1.2 After the satisfaction of the conditions set forth herein, and

21.3.1.3 After forty-five (45) days after the recording of the Notice of Completion by District.

21.3.2 No interest shall be paid on any retention, or on any amounts withheld due to a failure of the Contractor to perform, in accordance with the terms and conditions of the Contract Documents, except as provided to the contrary in any Escrow Agreement between the District and the Contractor pursuant to Public Contract Code section 22300.

21.4 Substitution of Securities

The District will permit the substitution of securities in accordance with the provisions of Public Contract Code section 22300.

22. UNCOVERING OF WORK

If a portion of the Work is covered without Inspector or Architect approval or not in compliance with the Contract Documents, it must, if required in writing by the District, the Project Inspector, or the Architect, be uncovered for the Project Inspector's or the Architect's observation and be corrected, replaced, and/or recovered at the Contractor's expense without change in the Contract Price or Contract Time.

23. NONCONFORMING WORK AND CORRECTION OF WORK

23.1 Nonconforming Work

23.1.1 Contractor shall promptly remove from Premises all Work identified by District as failing to conform to the Contract Documents whether incorporated or not. Contractor shall promptly replace and re-execute its own Work to comply with the Contract Documents without additional expense to the District and shall bear the expense of making good all work of other contractors destroyed or damaged by any removal or replacement pursuant hereto and/or any delays to the District or other Contractors caused thereby.

23.1.2 If Contractor does not remove Work that District has identified as failing to conform to the Contract Documents within a reasonable time, not to exceed **FORTY-EIGHT (48)** hours, District may remove it and may store any material at Contractor's expense. If Contractor does not pay expense(s) of that removal within ten (10) days' time thereafter, District may, upon ten (10) days' written notice, sell any material at auction or at private sale and shall deduct all costs and expenses incurred by the District and/or District may withhold those amounts from payment(s) to Contractor.

23.2 Correction of Work

23.2.1 Correction of Rejected Work

Pursuant to the notice provisions herein, the Contractor shall immediately correct the Work rejected by the District, the Architect, or the Project Inspector as failing to conform to the requirements of the Contract Documents, whether observed before or after Completion and whether or not fabricated, installed, or completed. The Contractor shall bear costs of correcting the rejected Work, including additional

testing, inspections, and compensation for the Inspector's or the Architect's services and expenses made necessary thereby.

23.2.2 Two-Year Warranty Corrections

If, within two (2) years after the date of Completion of the Work or a designated portion thereof, or after the date for commencement of warranties established hereunder, or by the terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the District to do so. This period of two (2) years shall be extended with respect to portions of the Work first performed after Completion by the period of time between Completion and the actual performance of the Work. This obligation hereunder shall survive District's acceptance of the Work under the Contract and termination of the Contract. The District shall give such notice promptly after discovery of the condition.

23.3 District's Right to Perform Work

23.3.1 If the Contractor should neglect to prosecute the Work properly or fail to perform any provisions of this contract, the District, after **FORTY-EIGHT (48)** hours written notice to the Contractor, may, without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor.

23.3.2 If it is found at any time, before or after completion of the Work, that Contractor has varied from the Drawings and/or Specifications, including, but not limited to, variation in material, quality, form, or finish, or in the amount or value of the materials and labor used, District may require at its option:

23.3.2.1 That all such improper Work be removed, remade or replaced, and all work disturbed by these changes be made good by Contractor at no additional cost to the District;

23.3.2.2 That the District deduct from any amount due Contractor the sum of money equivalent to the difference in value between the work performed and that called for by the Drawings and Specifications; or

23.3.2.3 That the District exercise any other remedy it may have at law or under the Contract Documents, including but not limited to the District hiring its own forces or another contractor to replace the Contractor's nonconforming Work, in which case the District shall either issue a deductive Change Order, a Construction Change Directive, or invoice the Contractor for the cost of that work. Contractor shall pay any invoices within thirty (30) days of receipt of same or District may withhold those amounts from payment(s) to Contractor.

24. TERMINATION AND SUSPENSION

24.1 District's Request for Assurances

If District at any time reasonably believes Contractor is or may be in default under this Contract, District may in its sole discretion notify Contractor of this fact and request

written assurances from Contractor of performance of Work and a written plan from Contractor to remedy any potential default under the terms this Contract that the District may advise Contractor of in writing. Contractor shall, within ten (10) calendar days of District's request, deliver a written cure plan that meets the District's requirements in its request for assurances. Contractor's failure to provide such written assurances of performance and the required written plan, within ten (10) calendar days of request, will constitute a material breach of this Contract sufficient to justify termination for cause.

24.2 District's Right to Terminate Contractor for Cause

24.2.1 Grounds for Termination: The District, in its sole discretion, may terminate the Contract and/or terminate the Contractor's right to perform the work of the Contract based upon any of the following:

24.2.1.1 Contractor refuses or fails to execute the Work or any separable part thereof with sufficient diligence as will ensure its completion within the time specified or any extension thereof, or

24.2.1.2 Contractor fails to complete said Work within the time specified or any extension thereof, or

24.2.1.3 Contractor persistently fails or refuses to perform Work or provide material of sufficient quality as to be in compliance with Contract Documents; or

24.2.1.4 Contractor persistently refuses, or repeatedly fails, except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials to complete the Work in the time specified; or

24.2.1.5 Contractor fails to make prompt payment to Subcontractors, or for material, or for labor; or

24.2.1.6 Contractor persistently disregards laws, or ordinances, or instructions of District; or

24.2.1.7 Contractor fails to supply labor, including that of Subcontractors, that is sufficient to prosecute the Work or that can work in harmony with all other elements of labor employed or to be employed on the Work; or

24.2.1.8 Contractor or its Subcontractor(s) is/are otherwise in breach, default, or in substantial violation of any provision of this Contract, including but not limited to a lapse in licensing or registration.

24.2.2 Notification of Termination

24.2.2.1 Upon the occurrence at District's sole determination of any of the above conditions, District may, without prejudice to any other right or remedy, serve written notice upon Contractor and its Surety of District's termination of this Contract and/or the Contractor's right to perform the work of the Contract. This notice will contain the reasons for termination. Unless, within three (3) days after the service of the notice, any and all condition(s) shall cease, and any and all violation(s) shall cease, or arrangement satisfactory to District for the

correction of the condition(s) and/or violation(s) be made, this Contract and/or the Contractor's right to perform the Work of the Contract shall cease and terminate. Upon termination, Contractor shall not be entitled to receive any further payment until the entire Work is finished.

24.2.2.2 Upon Termination, District may immediately serve written notice of tender upon Surety whereby Surety shall have the right to take over and perform this Contract only if Surety:

24.2.2.2.1 Within three (3) days after service upon it of the notice of tender, gives District written notice of Surety's intention to take over and perform this Contract; and

24.2.2.2.2 Commences performance of this Contract within three (3) days from date of serving of its notice to District.

24.2.2.3 Surety shall not utilize Contractor in completing the Project if the District notifies Surety of the District's objection to Contractor's further participation in the completion of the Project. Surety expressly agrees that any contractor which Surety proposes to fulfill Surety's obligations is subject to District's approval. District's approval shall not be unreasonably withheld, conditioned or delayed.

24.2.2.4 If Surety fails to notify District or begin performance as indicated herein, District may take over the Work and execute the Work to completion by any method it may deem advisable at the expense of Contractor and/or its Surety. Contractor and/or its Surety shall be liable to District for any excess cost or other damages the District incurs thereby. Time is of the essence in this Contract. If the District takes over the Work as herein provided, District may, without liability for so doing, take possession of and utilize in completing the Work such materials, appliances, plan, and other property belonging to Contractor as may be on the Site of the Work, in bonded storage, or previously paid for.

24.3 Termination of Contractor for Convenience

24.3.1 District in its sole discretion may terminate the Contract in whole or in part upon three (3) days' written notice to the Contractor.

24.3.2 Upon notice, Contractor shall:

24.3.2.1 Cease operations as directed by the District in the notice;

24.3.2.2 Take necessary actions for the protection and preservation of the Work as soon as possible; and

24.3.2.3 Terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

24.3.3 Within 30 days of the notice, Contractor submit to the District a payment application for the actual cost for labor, materials, and services performed, including all Contractor's and Subcontractor(s)' mobilization and/or demobilization costs, that

is unpaid. Contractor shall have no claims against the District except for the actual cost for labor, materials, and services performed that adequately documented through timesheets, invoices, receipts, or otherwise. District shall pay all undisputed invoice(s) for work performed until the notice of termination.

24.3.4 Under a termination for convenience, the District retains the right to all the options available to the District if there is a termination for cause.

24.4 Effect of Termination

24.4.1 Contractor shall, only if ordered to do so by the District, immediately remove from the Site all or any materials and personal property belonging to Contractor that have not been incorporated in the construction of the Work, or which are not in place in the Work. The District retains the right, but not the obligation, to keep and use any materials and personal property belonging to Contractor that have not been incorporated in the construction of the Work, or which are not in place in the Work. The Contractor and its Surety shall be liable upon the Performance Bond for all damages caused to the District by reason of the Contractor's failure to complete the Contract.

24.4.2 In the event that the District shall perform any portion of, or the whole of the Work, pursuant to the provisions of the General Conditions, the District shall not be liable nor account to the Contractor in any way for the time within which, or the manner in which, the Work is performed by the District or for any changes the District may make in the Work or for the money expended by the District in satisfying claims and/or suits and/or other obligations in connection with the Work.

24.4.3 In the event termination for cause is determined to have not been for cause, the termination shall be deemed to have been a termination for convenience effective as of the same date as the purported termination for cause.

24.4.4 In the event that the Contract is terminated for any reason, no allowances or compensation will be granted for the loss of any anticipated profit by the Contractor or any impact or impairment of Contractor's bonding capacity.

24.4.5 If the expense to the District to finish the Work exceeds the unpaid Contract Price, Contractor and Surety shall pay difference to District within twenty-one (21) days of District's request.

24.4.6 The District shall have the right (but shall have no obligation) to assume and/or assign to a general contractor or construction manager or other third party who is qualified and has sufficient resources to complete the Work, the rights of the Contractor under its subcontracts with any or all Subcontractors. In the event of an assumption or assignment by the District, no Subcontractor shall have any claim against the District or third party for Work performed by Subcontractor or other matters arising prior to termination of the Contract. The District or any third party, as the case may be, shall be liable only for obligations to the Subcontractor arising after assumption or assignment. Should the District so elect, the Contractor shall execute and deliver all documents and take all steps, including the legal assignment of its contractual rights, as the District may require, for the purpose of fully vesting in the District the rights and benefits of its Subcontractor under Subcontracts or other obligations or commitments. All payments due the Contractor hereunder shall

be subject to a right of offset by the District for expenses and damages suffered by the District as a result of any default, acts, or omissions of the Contractor. Contractor must include this assignment provision in all of its contracts with its Subcontractors.

24.4.7 The foregoing provisions are in addition to and not in limitation of any other rights or remedies available to District.

24.5 Emergency Termination of Public Contracts Act of 1949

24.5.1 This Contract is subject to termination as provided by sections 4410 and 4411 of the Government Code of the State of California, being a portion of the Emergency Termination of Public Contracts Act of 1949.

24.5.1.1 Section 4410 of the Government Code states:

In the event a national emergency occurs, and public work, being performed by contract, is stopped, directly or indirectly, because of the freezing or diversion of materials, equipment or labor, as the result of an order or a proclamation of the President of the United States, or of an order of any federal authority, and the circumstances or conditions are such that it is impracticable within a reasonable time to proceed with a substantial portion of the work, then the public agency and the contractor may, by written agreement, terminate said contract.

24.5.1.2 Section 4411 of the Government Code states:

Such an agreement shall include the terms and conditions of the termination of the contract and provision for the payment of compensation or money, if any, which either party shall pay to the other or any other person, under the facts and circumstances in the case.

24.5.2 Compensation to the Contractor shall be determined at the sole discretion of District on the basis of the reasonable value of the Work done, including preparatory work. As an exception to the foregoing and at the District's discretion, in the case of any fully completed separate item or portion of the Work for which there is a separate previously submitted unit price or item on the accepted schedule of values, that price shall control. The District, at its sole discretion, may adopt the Contract Price as the reasonable value of the work done or any portion thereof.

24.6 Suspension of Work

24.6.1 District in its sole discretion may suspend, delay or interrupt the Work in whole or in part for such period of time as the District may determine upon three (3) days written notice to the Contractor.

24.6.1.1 An adjustment may be made for changes in the cost of performance of the Work caused by any such suspension, delay or interruption. No adjustment shall be made to the extent:

24.6.1.1.1 That performance is, was or would have been so suspended, delayed or interrupted by another cause for which Contractor is responsible; or

24.6.1.1.2 That an equitable adjustment is made or denied under another provision of the Contract; or

24.6.1.1.3 That the suspension of Work was the direct or indirect result of Contractor's failure to perform any of its obligations hereunder.

24.6.1.2 Any adjustments in cost of performance may have a fixed or percentage fee as provided in the section on Format for Proposed Change Order herein. This amount shall be full compensation for all Contractor's and its Subcontractor(s)' changes in the cost of performance of the Contract caused by any such suspension, delay or interruption.

25. CLAIMS PROCESS

25.1 Obligation to File Claims for Disputed Work

25.1.1 Should Contractor otherwise seek extra time or compensation for any reason whatsoever ("Disputed Work"), then Contractor shall first follow procedures set forth in the Contract Documents including, without limitation, Articles 15, 16 and 17. A Notice of Potential Change or Proposed Change Order are less formal procedures that proceed the formal claim and do not constitute a Claim. A Claim also does not include correspondence, RFIs, vouchers, invoices, progress payment applications, or other routine or authorized form of requests for progress payments in compliance with the Contract. If a dispute remains, then Contractor shall give written notice to Owner that expressly invokes this Article 25 within the time limits set forth herein.

25.1.2 Contractor's sole and exclusive remedy for Disputed Work is to file a written claim setting forth Contractor's position as required herein within the time limits set forth herein.

25.2 Duty to Perform during during Claims Process

Contractor and its subcontractors shall continue to perform its Work under the Contract including the disputed work, and shall not cause a delay of the Work during any dispute, claim, negotiation, mediation, or arbitration proceeding, except by written agreement by the District.

25.3 Definition of a Claim

25.3.1 Pursuant to Public Contract Code section 9204, the term "Claim" means a separate demand by the Contractor, sent by registered mail or certified mail with return receipt requested, for one or more of the following:

25.3.1.1 A time extension, including without limitation, for relief of damages or penalties for delay assessed by the District under the Contract;

25.3.1.2 Payment by the District of money or damages arising from work done by, or on behalf of, the Contractor pursuant to the Contract and payment of which is not otherwise expressly provided for or to which Contractor is not otherwise entitled to; or

25.3.1.3 An amount of payment disputed by the District.

25.4 **Claims Presentation**

25.4.1 Form and Contents of Claim

25.4.1.1 If Contractor intends to apply for an increase in the Contract Price or Contract Time for any reason including, without limitation, the acts of District or its agents, Contractor shall, within thirty (30) days after the event giving rise to the Claim, give notice of the Claim in writing specifically identifying Contractor is invoking this Article 25 Claims Presentation.

25.4.1.2 The Claim shall include an itemized statement of the details and amounts of its Claim for any increase in the Contract Price of Contract Time as provided below, including a Time Impact Analysis and any and all other documentation substantiating Contractor's claimed damages:

25.4.1.2.1 The issues, events, conditions, circumstances and/or causes giving rise to the dispute, and shall show, in detail, the cause and effect of same;

25.4.1.2.2 Citation to provisions in the Contract Documents, statute sections, and/or case law entitling Contractor to an increase in the Contract Price or Contract Time;

25.4.1.2.3 The pertinent dates and/or durations and actual and/or anticipated effects on the Contract Price, Contract Schedule milestones and/or Contract Time adjustments;

25.4.1.2.4 The Time Impact Analysis of all time delays that shows actual time impact on the critical path; and

25.4.1.2.5 The line-item costs for labor, material, and/or equipment, if applicable, for all cost impacts priced like a change order according to Article 17 and must be updated monthly as to cost and entitlement if a continuing claim.

25.4.1.3 The Claim shall include the following certification by the Contractor:

25.4.1.3.1 The undersigned Contractor certifies under penalty of perjury that the attached dispute is made in good faith; that the supporting data is accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the adjustment for which Contractor believes the District is liable; and that I am duly authorized to certify the dispute on behalf of the Contractor.

25.4.1.3.2 Furthermore, Contractor understands that the value of the attached dispute expressly includes any and all of the Contractor's costs and expenses, direct and indirect, resulting from the Work performed on the Project, additional time required on the Project and/or resulting from delay to the Project including, without limitation, cumulative impacts. Contractor may not separately recover for overhead or other indirect costs. Any costs, expenses, damages, or time extensions not included are deemed waived.

25.4.2 Contractor shall bear all costs incurred in the preparation and submission of a claim.

25.4.3 Failure to timely submit a claim and the requisite supporting documentation shall constitute a waiver of Contractor's claim(s) against the District and Contractor's claims for compensation or an extension of time shall be forfeited and invalidated.

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25.5 Claim Resolution pursuant to Public Contract Code section 9204

Contractor may request to waive the claims procedure under Public Contract Code section 9204 and proceed directly to the commencement of a civil action or binding arbitration. If Contractor chooses to proceed, Contractor shall comply with the following steps.

25.5.1 STEP 1:

25.5.1.1 Upon receipt of a Claim by registered or certified mail, return receipt requested, including the documents necessary to substantiate it, the District shall conduct a reasonable review of the Claim and, within a period **not to exceed 45 days**, shall provide the Contractor a written statement identifying what portion of the Claim is disputed and what portion is undisputed. Upon receipt of a Claim, the District and Contractor may, **by mutual agreement, extend the time period** to provide a written statement. If the District needs approval from its governing body to provide the Contractor a written statement identifying the disputed portion and the undisputed portion of the Claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of Claim sent by registered mail or certified mail, return receipt requested, the District shall have **up to three (3) days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension**, expires to provide Contractor a written statement identifying the disputed portion and the undisputed portion.

25.5.1.1.1 Any payment due on an undisputed portion of the Claim shall be processed and made within 60 days after the District issues its written statement. Amounts not paid in a timely manner as required by this section, section 25.4, shall bear interest at seven percent (7%) per annum.

25.5.1.2 Upon receipt of a Claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable. In this instance, District and Contractor must

comply with the sections below regarding Public Contract Code section 20104 et seq. and Government Code Claim Act Claims.

25.5.1.3 If the District fails to issue a written statement, or to otherwise meet the time requirements of this section, this shall result in the Claim being deemed rejected in its entirety. A claim that is denied by reason of the District’s failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of Contractor.

25.5.2 STEP 2:

25.5.2.1 If Contractor disputes the District’s written response, or if the District fails to respond to a Claim within the time prescribed, Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the District shall schedule a meet and confer conference within 30 days for settlement of the dispute. Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the District shall provide the Contractor a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed.

25.5.2.1.1.1 Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the District issues its written statement. Amounts not paid in a timely manner as required by this section, section 25.4, shall bear interest at seven percent (7%) per annum.

25.5.3 STEP 3:

25.5.3.1 Any disputed portion of the claim, as identified by Contractor in writing, shall be submitted to nonbinding mediation, with the District and Contractor sharing the associated costs equally. The District and Contractor shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

25.5.3.1.1 For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

25.5.3.2 Unless otherwise agreed to by the District and Contractor in writing, the mediation conducted pursuant to this section shall excuse any further

obligation under Public Contract Code section 20104.4 to mediate after litigation has been commenced.

25.5.4 STEP 4:

25.5.4.1 If mediation under this section does not resolve the parties' dispute, the District may, but does not require arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program.

25.6 Subcontractor Pass-Through Claims

25.6.1 If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a District because privity of contract does not exist, the contractor may present to the District a Claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that Contractor present a Claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the Claim be presented to the District shall furnish reasonable documentation to support the Claim.

25.6.2 Within 45 days of receipt of this written request from a subcontractor, Contractor shall notify the subcontractor in writing as to whether the Contractor presented the Claim to the District and, if Contractor did not present the Claim, provide the subcontractor with a statement of the reasons for not having done so.

25.6.3 The Contractor shall bind all its Subcontractors to the provisions of this section and will hold the District harmless against Claims by Subcontractors.

25.7 Government Code Claim Act Claim

25.7.1 If a claim, or any portion thereof, remains in dispute upon satisfaction of all applicable Claim Resolution requirements the Contractor shall comply with all claims presentation requirements as provided in Chapter 1 (commencing with section 900) and Chapter 2 (commencing with section 910) of Part 3 of Division 3.6 of Title 1 of Government Code as a condition precedent to the Contractor's right to bring a civil action against the District.

25.7.2 Contractor shall bear all costs incurred in the preparation, submission and administration of a Claim. Any claims presented in accordance with the Government Code must affirmatively indicate Contractor's prior compliance with the claims procedure herein of the claims asserted.

25.7.3 For purposes of those provisions, the running of the time within which a claim pursuant to Public Contract Code section 20104.2 only must be presented to the District shall be tolled from the time the claimant submits his or her written claim pursuant to subdivision (a) until the time that claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

25.8 Claim Resolution pursuant to Public Contract Code section 20104 et seq.

25.8.1 In the event of a disagreement between the parties as to performance of the Work, the interpretation of this Contract, or payment or nonpayment for Work performed or not performed, the parties shall attempt to resolve all Claims of three hundred seventy-five thousand dollars (\$375,000) or less which arise between Contractor and District by those procedures set forth in Public Contract Code section 20104, et seq., to the extent applicable.

25.8.1.1 Contractor shall file with the District any written Claim, including the documents necessary to substantiate it, upon the application for final payment.

25.8.1.2 For claims of less than fifty thousand dollars (\$50,000), the District shall respond in writing within forty-five (45) days of receipt of the Claim or may request in writing within thirty (30) days of receipt of the Claim any additional documentation supporting the claim or relating to defenses or claims the District may have against the Contractor.

25.8.1.2.1 If additional information is required, it shall be requested and provided by mutual agreement of the parties.

25.8.1.2.2 District's written response to the documented Claim shall be submitted to the Contractor within fifteen (15) days after receipt of the further documentation or within a period of time no greater than that taken by the Contractor to produce the additional information, whichever is greater.

25.8.1.3 For claims of over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), the District shall respond in writing to all written Claims within sixty (60) days of receipt of the claim, or may request, in writing, within thirty (30) days of receipt of the Claim any additional documentation supporting the Claim or relating to defenses or claims the District may have against the Contractor.

25.8.1.3.1 If additional information is required, it shall be requested and provided upon mutual agreement of the District and the Contractor.

25.8.1.3.2 The District's written response to the claim, as further documented, shall be submitted to the Contractor within thirty (30) days after receipt of the further documentation, or within a period of time no greater than that taken by the Contractor to produce the additional information or requested documentation, whichever is greater.

25.8.1.4 If Contractor disputes the District's written response, or the District fails to respond within the time prescribed, Contractor may so notify the District, in writing, either within fifteen (15) days of receipt of the District's response or within fifteen (15) days of the District's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the District shall schedule a meet and confer conference within thirty (30) days for settlement of the dispute.

25.8.1.5 Following the meet and confer conference, if the claim or any portion of it remains in dispute, the Contractor may file a claim as provided in Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For purposes of those provisions the running of the time within which a claim must be filed shall be tolled from the time the Contractor submits its written Claim until the time the Claim is denied, including any period of time utilized by the meet and confer process.

25.8.1.6 For any civil action filed to resolve claims filed pursuant to this section, within sixty (60) days, but no earlier than thirty (30) days, following the filing of responsive pleadings, the court shall submit the matter to nonbinding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within fifteen (15) days by both parties of a disinterested third person as mediator, shall be commenced within thirty (30) days of the submittal, and shall be concluded within fifteen (15) days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court or by stipulation of both parties. If the parties fail to select a mediator within the 15-day period, any party may petition the court to appoint the mediator.

25.8.1.7 If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of the Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1141.11 of that code. The Civil Discovery Act of 1986, (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration.

25.8.1.8 The District shall not fail to pay money as to any portion of a Claim which is undisputed except as otherwise provided in the Contract Documents. In any suit filed pursuant to this section, the District shall pay interest due at the legal rate on any arbitration award or judgment. Interest shall begin to accrue on the date the suit is filed in a court of law.

25.8.2 Contractor shall bind its Subcontractors to the provisions of this Section and will hold the District harmless against disputes by Subcontractors.

25.9 Claim Procedure Compliance

25.9.1 Failure to submit and administer claims as required in Article 25 shall waive Contractor's right to claim on any specific issues not included in a timely submitted claim. Claim(s) not raised in a timely protest and timely claim submitted under this Article 25 may not be asserted in any subsequent litigation, Government Code Claim, or legal action.

25.9.2 District shall not be deemed to waive any provision under this Article 25, if at Owner's sole discretion, a claim is administered in a manner not in accord with this Article 25. Waivers or modifications of this Article 25 may only be made by a signed change order approved as to form by legal counsel for both District and Contractor; oral or implied modifications shall be ineffective.

25.10 Claim Resolution Non-Applicability

25.10.1 The procedures for dispute and claim resolutions set forth in this Article shall not apply to the following:

25.10.1.1 Personal injury, wrongful death or property damage claims;

25.10.1.2 Latent defect or breach of warranty or guarantee to repair;

25.10.1.3 Stop payment notices;

25.10.1.4 District's rights set forth in the Article on Suspension and Termination;

25.10.1.5 Disputes arising out of labor compliance enforcement by the Department of Industrial Relations; or

25.10.1.6 District rights and obligations as a public entity set forth in applicable statutes; provided, however, that penalties imposed against a public entity by statutes, including, but not limited to, Public Contract Code sections 20104.50 and 7107, shall be subject to the Claim Resolution requirements provided in this Article.

25.11 Attorney's Fees

25.11.1 Should litigation be necessary to enforce any terms or provisions of this Agreement, then each party shall bear its own litigation and collection expenses, witness fees, court costs, and attorney's fees.

26. STATE LABOR, WAGE & HOUR, APPRENTICE, AND RELATED PROVISIONS

26.1 Labor Compliance and Enforcement

Since this Project is subject to labor compliance and enforcement by the Department of Industrial Relations ("DIR"), Contractor specifically acknowledges and understands that it shall perform the Work of this Agreement while complying with all the applicable provisions of Division 2, Part 7, Chapter 1, of the Labor Code and Title 8 of the California Code of Regulations, including, without limitation, the requirement that the Contractor and all Subcontractors shall timely furnish complete and accurate electronic certified payroll records directly to the DIR. The District may not issue payment if this requirement is not met.

26.2 Wage Rates, Travel, and Subsistence

26.2.1 Pursuant to the provisions of Article 2 (commencing at section 1770), Chapter 1, Part 7, Division 2, of the Labor Code, the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work in the locality in which this public work is to be performed for each craft, classification, or type of worker needed to execute this Contract are on file at the District's principal office and copies will be made available to any interested party on request. Contractor shall obtain and post a copy of these wage rates at the job site.

26.2.2 Holiday and overtime work, when permitted by law, shall be paid for at the general prevailing rate of per diem wages for holiday and overtime work on file with the Director of the Department of Industrial Relations, unless otherwise specified. The holidays upon which those rates shall be paid need not be specified by the District, but shall be all holidays recognized in the applicable collective bargaining agreement. If the prevailing rate is not based on a collectively bargained rate, the holidays upon which the prevailing rate shall be paid shall be as provided in Section 6700 of the Government Code.

26.2.3 Contractor shall pay and shall cause to be paid each worker engaged in Work on the Project the general prevailing rate of per diem wages determined by the Director of the Department of Industrial Relations, regardless of any contractual relationship which may be alleged to exist between Contractor or any Subcontractor and such workers.

26.2.4 If during the period this bid is required to remain open, the Director of the Department of Industrial Relations determines that there has been a change in any prevailing rate of per diem wages in the locality in which the Work under the Contract is to be performed, such change shall not alter the wage rates in the Notice to Bidders or the Contract subsequently awarded.

26.2.5 Pursuant to Labor Code section 1775, Contractor shall, as a penalty to District, forfeit the statutory amount (believed by the District to be currently up to two hundred dollars (\$200) for each calendar day, or portion thereof, for each worker paid less than the prevailing rates, determined by the District and/or the Director, for the work or craft in which that worker is employed for any public work done under Contract by Contractor or by any Subcontractor under it. The difference between such prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the prevailing wage rate shall be paid to each worker by Contractor.

26.2.6 Any worker employed to perform Work on the Project, which Work is not covered by any classification listed in the general prevailing wage rate of per diem wages determined by the Director, shall be paid not less than the minimum rate of wages specified therein for the classification which most nearly corresponds to Work to be performed by him, and such minimum wage rate shall be retroactive to time of initial employment of such person in such classification.

26.2.7 Pursuant to Labor Code section 1773.1, per diem wages are deemed to include employer payments for health and welfare, pension, vacation, travel time, subsistence pay, and apprenticeship or other training programs authorized by Labor Code section 3093, and similar purposes.

26.2.8 Contractor shall post at appropriate conspicuous points on the Site of Project, a schedule showing all determined minimum wage rates and all authorized deductions, if any, from unpaid wages actually earned. In addition, Contractor shall post a sign-in log for all workers and visitors to the Site, a list of all subcontractors of any tier on the Site, and the required Equal Employment Opportunity poster(s).

26.3 Hours of Work

26.3.1 As provided in article 3 (commencing at section 1810), chapter 1, part 7, division 2, of the Labor Code, eight (8) hours of labor shall constitute a legal day's work. The time of service of any worker employed at any time by Contractor or by any Subcontractor on any subcontract under this Contract upon the Work or upon any part of the Work contemplated by this Contract shall be limited and restricted by Contractor to eight (8) hours per day, and forty (40) hours during any one week, except as hereinafter provided. Notwithstanding the provisions hereinabove set forth, Work performed by employees of Contractor in excess of eight (8) hours per day and forty (40) hours during any one week, shall be permitted upon this public work upon compensation for all hours worked in excess of eight (8) hours per day at not less than one and one-half times the basic rate of pay.

26.3.2 Contractor shall keep and shall cause each Subcontractor to keep an accurate record showing the name of and actual hours worked each calendar day and each calendar week by each worker employed by Contractor in connection with the Work or any part of the Work contemplated by this Contract. The record shall be kept open at all reasonable hours to the inspection of District and to the Division of Labor Standards Enforcement of the DIR.

26.3.3 Pursuant to Labor Code section 1813, Contractor shall as a penalty to the District forfeit the statutory amount (believed by the District to be currently twenty-five dollars (\$25)) for each worker employed in the execution of this Contract by Contractor or by any Subcontractor for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one calendar day and forty (40) hours in any one calendar week in violation of the provisions of article 3 (commencing at section 1810), chapter 1, part 7, division 2, of the Labor Code.

26.3.4 Any Work necessary to be performed after regular working hours, or on Sundays or other holidays shall be performed without additional expense to the District.

26.4 Payroll Records

26.4.1 Contractor shall upload, and shall cause each Subcontractor performing any portion of the Work under this Contract to upload, an accurate and complete certified payroll record ("CPR") electronically using DIR's eCPR System by uploading the CPRs by electronic XML file or entering each record manually using the DIR's iform (or current form) online on a weekly basis and within ten (10) days of any request by the District or Labor Commissioner at <http://www.dir.ca.gov/Public-Works/Certified-Payroll-Reporting.html> or current application and URL, showing the name, address, social security number, work classification, straight-time, and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and/or each Subcontractor in connection with the Work.

26.4.1.1 The CPRs enumerated hereunder shall be filed directly with the DIR on a weekly basis or to the requesting party, whether the District or DIR, within ten (10) days after receipt of each written request. The CPRs from the Contractor and each Subcontractor for each week shall be provided on or before Wednesday

of the week following the week covered by the CPRs. District may not make any payment to Contractor until:

26.4.1.1.1 Contractor and/or its Subcontractor(s) provide CPRs acceptable to the DIR; and

26.4.1.1.2 Any delay in Contractor and/or its Subcontractor(s) providing CPRs to the DIR in a timely manner may directly delay Contractor's payment.

26.4.2 All CPRs shall be available for inspection at all reasonable hours at the principal office of Contractor on the following basis:

26.4.2.1 A certified copy of an employee's CPR shall be made available for inspection or furnished to the employee or his/her authorized representative on request.

26.4.2.2 CPRs shall be made available for inspection or furnished upon request to a representative of District, Division of Labor Standards Enforcement, Division of Apprenticeship Standards, and/or the DIR.

26.4.2.3 CPRs shall be made available upon request by the public for inspection or copies thereof made; provided, however, that a request by the public shall be made through the District, Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement. If the requested CPRs have not been provided pursuant to the provisions herein, the requesting party shall, prior to being provided the records, reimburse the costs of preparation by Contractor, Subcontractors, and the entity through which the request was made. The public shall not be given access to the records at the principal office of Contractor.

26.4.3 Any copy of records made available for inspection as copies and furnished upon request to the public or any public agency by District, Division of Apprenticeship Standards, or Division of Labor Standards Enforcement shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address, and social security number. The name and address of Contractor awarded Contract or performing Contract shall not be marked or obliterated.

26.4.4 Contractor shall inform District of the location of the records enumerated hereunder, including the street address, city, and county, and shall, within five (5) working days, provide a notice of change of location and address.

26.4.5 In the event of noncompliance with the requirements of this section, Contractor shall have ten (10) days in which to comply subsequent to receipt of written notice specifying in what respects Contractor must comply with this section. Should noncompliance still be evident after the ten (10) day period, Contractor shall, as a penalty to District, forfeit up to one hundred dollars (\$100) for each calendar day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Labor Commissioner, these penalties shall be withheld from progress payments then due.

26.4.6 [RESERVED]

26.5 [RESERVED]

26.6 Apprentices

26.6.1 Contractor acknowledges and agrees that, if this Contract involves a dollar amount greater than or a number of working days greater than that specified in Labor Code section 1777.5, then this Contract is governed by the provisions of Labor Code Section 1777.5. It shall be the responsibility of Contractor to ensure compliance with this Article and with Labor Code section 1777.5 for all apprenticeship occupations.

26.6.2 Apprentices of any crafts or trades may be employed and, when required by Labor Code section 1777.5, shall be employed provided they are properly registered in full compliance with the provisions of the Labor Code.

26.6.3 Every such apprentice shall be paid the standard wage paid to apprentices under the regulations of the craft or trade at which he/she is employed, and shall be employed only at the work of the craft or trade to which she/he is registered.

26.6.4 Only apprentices, as defined in section 3077 of the Labor Code, who are in training under apprenticeship standards and written apprentice agreements under chapter 4 (commencing at section 3070), division 3, of the Labor Code, are eligible to be employed. The employment and training of each apprentice shall be in accordance with the provisions of the apprenticeship standards and apprentice agreements under which he/she is training.

26.6.5 Pursuant to Labor Code section 1777.5, if that section applies to this Contract as indicated above, Contractor and any Subcontractors employing workers in any apprenticeable craft or trade in performing any Work under this Contract shall apply to the applicable joint apprenticeship committee for a certificate approving the Contractor or Subcontractor under the applicable apprenticeship standards and fixing the ratio of apprentices to journeymen employed in performing the Work.

26.6.6 Pursuant to Labor Code section 1777.5, if that section applies to this Contract as indicated above, Contractor and any Subcontractor may be required to make contributions to the apprenticeship program.

26.6.7 If Contractor or Subcontractor willfully fails to comply with Labor Code section 1777.5, then, upon a determination of noncompliance by the Administrator of Apprenticeship, it shall:

26.6.7.1 Be denied the right to bid on any subsequent project for one (1) year from the date of such determination;

26.6.7.2 Forfeit as a penalty to District the full amount as stated in Labor Code section 1777.7. Interpretation and enforcement of these provisions shall be in accordance with the rules and procedures of the California Apprenticeship Council and under the authority of the Chief of the Division of Apprenticeship Standards.

26.6.8 Contractor and all Subcontractors shall comply with Labor Code section 1777.6, which section forbids certain discriminatory practices in the employment of apprentices.

26.6.9 Contractor shall become fully acquainted with the law regarding apprentices prior to commencement of the Work. Special attention is directed to sections 1777.5, 1777.6, and 1777.7 of the Labor Code, and title 8, California Code of Regulations, section 200 et seq. Questions may be directed to the State Division of Apprenticeship Standards, 455 Golden Gate Avenue, 9th floor, San Francisco, California 94102.

26.7 Non-Discrimination

26.7.1 Contractor herein agrees to comply with the provisions of the California Fair Employment and Housing Act as set forth in part 2.8 of division 3 of the California Government Code, commencing at section 12900; the Federal Civil Rights Act of 1964, as set forth in Public Law 88-352, and all amendments thereto; Executive Order 11246; and all administrative rules and regulations found to be applicable to Contractor and Subcontractor.

26.7.2 Special requirements for Federally Assisted Construction Contracts: During the performance of this Contract, Contractor agrees to incorporate in all subcontracts the provisions set forth in Chapter 60-1.4(b) of Title 41 published in Volume 33 No. 104 of the Federal Register dated May 28, 1968.

26.8 Labor First Aid

Contractor shall maintain emergency first aid treatment for Contractor’s workers on the Project which complies with the Federal Occupational Safety and Health Act of 1970 (29 U.S.C. § 651 *et seq.*) and the California Occupational Safety and Health Act of 1973 (Lab. Code, § 6300 *et seq.*; 8 Cal. Code of Regs., § 330 *et seq.*).

27. [RESERVED]

28. MISCELLANEOUS

28.1 Assignment of Antitrust Actions

28.1.1 Section 7103.5(b) of the Public Contract Code states:

In entering into a public works contract or subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, which assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

28.1.2 Section 4552 of the Government Code states:

In submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act (Chapter 2 (commencing with Section

16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, materials, or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the bidder.

28.1.3 Section 4553 of the Government Code states:

If an awarding body or public purchasing body receives, either through judgment or settlement, a monetary recovery for a cause of action assigned under this chapter, the assignor shall be entitled to receive reimbursement for actual legal costs incurred and may, upon demand, recover from the public body any portion of the recovery, including treble damages, attributable to overcharges that were paid by the assignor but were not paid by the public body as part of the bid price, less the expenses incurred in obtaining that portion of the recovery.

28.1.4 Section 4554 of the Government Code states:

Upon demand in writing by the assignor, the assignee shall, within one year from such demand, reassign the cause of action assigned under this part if the assignor has been or may have been injured by the violation of law for which the cause of action arose and (a) the assignee has not been injured thereby, or (b) the assignee declines to file a court action for the cause of action.

28.1.5 Under this Article, "public purchasing body" is District and "bidder" is Contractor.

28.2 **Excise Taxes**

If, under Federal Excise Tax Law, any transaction hereunder constitutes a sale on which a Federal Excise Tax is imposed and the sale is exempt from such Federal Excise Tax because it is a sale to a State or Local Government for its exclusive use, District, upon request, will execute documents necessary to show (1) that District is a political subdivision of the State for the purposes of such exemption, and (2) that the sale is for the exclusive use of District. No Federal Excise Tax for such materials shall be included in any Contract Price.

28.3 **Taxes**

Contract Price is to include any and all applicable sales taxes or other taxes that may be due in accordance with section 7051 et seq. of the Revenue and Taxation Code, Regulation 1521 of the State Board of Equalization or any other tax code that may be applicable.

28.4 **Shipments**

Contractor is responsible for any or all damage or loss to shipments until delivered and accepted on Site, as indicated in the Contract Documents. There must be no charge for containers, packing, unpacking, drayage, or insurance. The total Contract Price shall be all inclusive (including sales tax) and no additional costs of any type will be considered.

28.5 Compliance with Government Reporting Requirements

If this Contract is subject to federal or other governmental reporting requirements because of federal or other governmental financing in whole or in part for the Project of which it is part, or for any other reason, Contactor shall comply with those reporting requirements at the request of the District at no additional cost.

END OF DOCUMENT

DOCUMENT 00 73 13

SPECIAL CONDITIONS

THIS DOCUMENT MUST BE ADAPTED FOR EACH PROJECT – Delete any provision that is not applicable or if no change from the provision in the General Conditions.

*** THIS LIST OF SPECIAL CONDITION PROVISIONS IS FOR REFERENCE ONLY. REMOVE THIS PAGE BEFORE USING THIS DOCUMENT. ***

1. Mitigation Measures
2. Modernization Projects
3. Badge Policy for Contractors
4. Substitution for Specified Items
5. Weather Days
6. Insurance Policy Limits
7. Permits, Certificates, Licenses, Fees, Approval
8. Project Labor Agreement/Payroll Records
9. As-Builts and Record Drawings
10. Construction Manager
11. Program Manager
12. Federal Funds
13. Separation of Documentation for Each Increment (Increment #1 and Increment #2)
14. Project Management Information System (PMIS)
15. Preliminary Schedule of Values
27. Federal Labor, Wage & Labor, Apprenticeship, and Related Provisions

DOCUMENT 00 73 13

SPECIAL CONDITIONS**1. Mitigation Measures**

Contractor shall comply with all applicable mitigation measures, if any, adopted by any public agency with respect to this Project pursuant to the California Environmental Quality Act (CEQA). (Public Resources Code section 21000 *et seq.*)

See Appendix A for the Mitigation Monitoring and Reporting Program (MMRP) for the Merritt College Child Development Center Project. The General Contractor shall review and be familiar with the MMRP. The mitigation measures that are the responsibility of the contractor to implement and monitor include but are not limited to:

- (A) Air Quality: AIR-1
- (B) Hazards and Hazardous Materials: HAZARDS-1
- (C) Noise: NOISE-1a; NOISE-1c; NOISE-1d

2. Modernization Projects

2.1 Access. Access to the school buildings and entry to buildings, classrooms, restrooms, mechanical rooms, electrical rooms, or other rooms, for construction purposes, must be coordinated with District and onsite District personnel before Work is to start. Unless agreed to otherwise in writing, only a school custodian will be allowed to unlock and lock doors in existing building(s). The custodian will be available only while school is in session. If a custodian is required to arrive before 7:00 a.m. or leave after 3:30 p.m. to accommodate Contractor's Work, the overtime wages for the custodian will be paid by the Contractor, unless at the discretion of the District, other arrangements are made in advance.

2.2 Keys. Upon request, the District may, at its own discretion, provide keys to the school site for the convenience of the Contractor. The Contractor agrees to pay all expenses to re-key the entire school site and all other affected District buildings if the keys are lost or stolen, or if any unauthorized party obtains a copy of a key or access to the school.

2.3 Maintaining Services. The Contractor is advised that Work is to be performed in spaces regularly scheduled for instruction. Interruption and/or periods of shutdown of public access, electrical service, water service, lighting, or other utilities shall be only as arranged in advance with the District. Contractor shall provide temporary services to all facilities interrupted by Contractor's Work.

2.4 Maintaining Utilities. The Contractor shall maintain in operation during duration of Contract, drainage lines, storm drains, sewers, water, gas, electrical, steam, and other utility service lines within working area.

2.5 Confidentiality. Contractor shall maintain the confidentiality of all information, documents, programs, procedures and all other items that Contractor

encounters while performing the Work. This requirement shall be ongoing and shall survive the expiration or termination of this Contract and specifically includes, without limitation, all student, parent, and employee disciplinary information and health information.

2.6 Work during Instructional Time. By submitting its bid, Contractor affirms that Work may be performed during ongoing instruction in existing facilities. If so, Contractor agrees to cooperate to the best of its ability to minimize any disruption to school operations and any use of school facilities by the public up to, and including, rescheduling specific work activities, at no additional cost to District.

2.7 No Work during Student Testing. Contractor shall, at no additional cost to the District and at the District's request, coordinate its Work to not disturb District students including, without limitation, not performing any Work when students at the Site are taking State or Federally-required tests.

3. Badge Policy for Contractors

All Contractors doing work for the District will provide their workers with identification badges. These badges will be worn by all members of the Contractor's staff who are working in a District facility.

3.1 Badges must be filled out in full and contain the following information:

3.1.1 Name of Contractor

3.1.2 Name of Employee

3.1.3 Contractor's address and phone number

3.2 Badges are to be worn when the Contractor or his/her employees are on site and must be visible at all times. Contractors must inform their employees that they are required to allow District employees, the Architect, the Construction Manager, the Program Manager, or the Project Inspector to review the information on the badges upon request.

3.3 Continued failure to display identification badges as required by this policy may result in the individual being removed from the Project or assessment of fines against the Contractor.

4. Substitutions for Specified Items

Replace Section 1.7 in the General Conditions with the following provisions:

4.1 Whenever in the Specifications any materials, process, or article is indicated or specified by grade, patent, or proprietary name, or by name of manufacturer, that Specification shall be deemed to be followed by the words "or equal." Contractor may,

unless otherwise stated, offer any material, process, or article that shall be substantially equal or better in every respect to that so indicated or specified.

4.1.1 If the material, process, or article offered by Contractor is not, in the opinion of the District, substantially equal or better in every respect to that specified, then Contractor shall furnish the material, process, or article specified in the Specifications without any additional compensation or change order.

4.1.2 This provision shall not be applicable with respect to any material, product, thing or service for which District made findings and gave notice in accordance with Public Contract Code section 3400(c); therefore, Contractor shall not be entitled to request a substitution with respect to those materials, products or services.

4.2 A request for a substitution shall be submitted as follows:

4.2.1 Contractor shall notify the District in writing of any request for a substitution at least ten (10) days prior to bid opening as indicated in the Instructions to Bidders.

4.2.2 Requests for Substitutions after award of the Contract shall be submitted within thirty-five (35) days of the date of the Notice of Award.

4.3 Within 35 days after the date of the Notice of Award, Contractor shall provide data substantiating a request for substitution of "an equal" item, including but not limited to the following:

4.3.1 All variations of the proposed substitute from the material specified including, but not limited to, principles of operation, materials, or construction finish, thickness or gauge of materials, dimensions, weight, and tolerances;

4.3.2 Available maintenance, repair or replacement services;

4.3.3 Increases or decreases in operating, maintenance, repair, replacement, and spare parts costs;

4.3.4 Whether or not acceptance of the substitute will require other changes in the Work (or in work performed by the District or others under Contract with the District); and

4.3.5 The time impact on any part of the Work resulting directly or indirectly from acceptance of the proposed substitute.

4.4 No substitutions shall be made until approved, in writing, by the District. The burden of proof as to equality of any material, process, or article shall rest with Contractor. The Contractor warrants that if substitutes are approved:

4.4.1 The proposed substitute is equal or superior in all respects to that specified, and that such proposed substitute is suitable and fit for the intended

purpose and will perform adequately the function and achieve the results called for by the general design and the Contract Documents;

4.4.2 The Contractor provides the same warranties and guarantees for the substitute that would be provided for that specified;

4.4.3 The Contractor shall be fully responsible for the installation of the substitute and any changes in the Work required, either directly or indirectly, because of the acceptance of such substitute, with no increase in Contract Price or Contract Time. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time;

4.4.4 The Contractor shall be responsible for any re-design costs occasioned by District's acceptance and/or approval of any substitute; and

4.4.5 The Contractor shall, in the event that a substitute is less costly than that specified, credit the District with one hundred percent (100%) of the net difference between the substitute and the originally specified material. In this event, the Contractor agrees to execute a deductive Change Order to reflect that credit.

4.5 In the event Contractor furnishes a material, process, or article more expensive than that specified, the difference in the cost of that material, process, or article so furnished shall be borne by Contractor.

4.6 In no event shall the District be liable for any increase in Contract Price or Contract Time due to any claimed delay in the evaluation of any proposed substitute or in the acceptance or rejection of any proposed substitute.

4.7 Contractor shall be responsible for any costs the District incurs for professional services, DSA fees, or delay to the Project Schedule, if applicable, while DSA reviews changes for the convenience of Contractor and/or to accommodate Contractor's means and methods. District may deduct those costs from any amounts owing to the Contractor for the review of the request for substitution, even if the request for substitution is not approved. District, at its sole discretion, shall deduct from the payments due to and/or invoice Contractor for all the professional services and/or DSA fees or delay to the Project Schedule, if applicable, while DSA reviews changes for the convenience of Contractor and/or to accommodate Contractor's means and methods arising herein.

5. Weather Days

Replace Section 15.2.1.5 in the General Conditions with the following:

15.2.1.5 The number of days of Adverse Weather exceeds the following parameters:

January	11	July	0
February	10	August	0
March	10	September	1

April	6	October	4
May	3	November	7
June	1	December	10

6. Insurance Policy Limits

All of Contractor’s insurance shall be with insurance companies with an A.M. Best rating of no less than **A- or A:VII**. The limits of insurance shall not be less than:

Commercial General Liability	Product Liability and Completed Operations, Fire Damage Liability – Split Limit	\$2,000,000 per occurrence; \$4,000,000 aggregate
Automobile Liability – Any Auto	Combined Single Limit	\$1,000,000
Workers’ Compensation		Statutory limits pursuant to State law
Employers’ Liability		\$1,000,000
Builder’s Risk (Course of Construction)		Issued for the value and scope of Work indicated herein.
Pollution Liability		\$1,000,000 per claim; \$2,000,000 aggregate

7. Permits, Certificates, Licenses, Fees, Approvals

7.1 Payment for Permits, Certificates, Licenses, Fees, and Approvals. As required in the General Conditions, the Contractor shall secure and pay for all permits, licenses, approvals, and certificates necessary for the prosecution of the Work with the exception of the following:

7.2 General Permit For Storm Water Discharges Associated With Construction and Land Disturbance Activities

7.2.1 Contractor acknowledges that all California school districts are obligated to develop and implement the following requirements for the discharge of storm water to surface waters from its construction and land disturbance activities (storm water requirements):

7.2.1.1 Projects that disturb less than one acre of land and are not part of a larger common plan of development or sale, in accordance with Title 24,

Chapter 5.106.1, shall prevent the pollution of stormwater runoff from the construction activities through one or more of the following measures:

7.2.1.1.1 Comply with lawfully enacted stormwater management and/or erosion control ordinance.

7.2.1.1.2 Prevent loss of soil through wind or water erosion by adhering to a Storm Water Pollution Prevention Plan ("SWPPP") implementing an effective combination of erosion and sediment control and good housekeeping best management practices ("BMPs").

7.2.1.1.2.1 Soil loss BMP's that should be considered for implementation as appropriate for each project include, but are not limited to, the following:

7.2.1.1.2.1.1 Scheduling construction activity during dry weather, when possible.

7.2.1.1.2.1.2 Preservation of natural features, vegetation, soil, and buffers around surface waters.

7.2.1.1.2.1.3 Drainage swales or lined ditches to control stormwater flow.

7.2.1.1.2.1.4 Mulching or hydroseeding to stabilize disturbed soils.

7.2.1.1.2.1.5 Erosion control to protect slopes.

7.2.1.1.2.1.6 Protection of storm drain inlets (gravel bags or catch basin inserts).

7.2.1.1.2.1.7 Perimeter sediment control (perimeter silt fence, fiber rolls).

7.2.1.1.2.1.8 Sediment trap or sediment basin to retain sediment on site.

7.2.1.1.2.1.9 Stabilized construction exits.

7.2.1.1.2.1.10 Wind erosion control.

7.2.1.1.2.1.11 Other soil loss BMP's acceptable to the enforcing agency.

7.2.1.1.2.2 Good housekeeping BMP's to manage construction equipment, materials, non-stormwater discharges, and wastes that should be considered for implementation as appropriate for each project include, but are not limited to, the following:

7.2.1.1.2.2.1 Dewatering activities.

- 7.2.1.1.2.2.2** Material handling and waste management.
- 7.2.1.1.2.2.3** Building materials stockpile management.
- 7.2.1.1.2.2.4** Management of washout areas (concrete, paints, stucco, etc.).
- 7.2.1.1.2.2.5** Control of vehicle/equipment fueling to contractor’s staging area.
- 7.2.1.1.2.2.6** Vehicle and equipment cleaning performed off site.
- 7.2.1.1.2.2.7** Spill prevention and control.
- 7.2.1.1.2.2.8** Other housekeeping BMP’s acceptable to the enforcing agency.

7.2.1.2 Projects that disturb one acre or more of land, or disturb less than one acre of land but are part of a larger common plan of development or sale shall comply with all lawfully enacted stormwater discharge regulations in accordance with Title 24, Chapter 5.106.2.

7.2.2 Contractor shall comply with any District storm water requirements that are approved by the District and applicable to the Project, at no additional cost to the District.

7.2.3 At no additional cost to the District, Contractor shall provide a Qualified Storm Water Practitioner who shall be onsite and implement and monitor any and all SWPPP requirements applicable to the Project, including but not limited to:

7.2.3.1 At least forty eight (48) hours prior to a forecasted rain event, implementing the Rain Event Action Plan (REAP) for any rain event requiring implementation of the REAP, including any erosion and sediment control measures needed to protect all exposed portions of the site; and

7.2.3.2 Monitoring any Numeric Action Levels (NALs), if applicable.

8. Project Labor Agreement/Payroll Records

The District has entered into a Project Labor Agreement (“PLA”), which covers this Project. Accordingly, the following provision is added as Section 26.4.6:

26.4.6 As Contractor and its subcontractors have agreed to be bound by the terms of the PLA entered into by the District [on or about / dated] _____, Contractor and its subcontractors may be excused from uploading CPRs electronically using DIR’s eCPR System by uploading the CPRs by electronic XML file or entering each record manually using the DIR’s iform (or current form) online at <http://www.dir.ca.gov/Public-Works/Certified-Payroll-Reporting.html> , or by using a more current application and URL. However, within ten (10) days of any request by

the District or Labor Commissioner, Contractor and its subcontractors shall provide CPRs showing the name, address, social security number, work classification, straight time, and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and/or each subcontractor in connection with the Work.

9. As-Builts and Record Drawings

9.1 When called for by Division 1, Contractor shall submit As-Built Drawings pursuant to the Contract Documents consisting of one set of computer-aided design and drafting ("CADD") files in .DWG format, plus one set of As Built Drawings in electronic PDF format.

9.2 Contractor shall submit Record Drawings pursuant to the Contract Documents consisting of one set of computer-aided design and drafting ("CADD") files in in .DWG format, plus one set of Record Drawings on electronic PDF format.

10. Construction Manager

The District will use a Construction Manager on the Project that is the subject of this Contract. Kitchell CEM is the Construction Manager for this Project.

11. Program Manager

AECOM is the Program Manager designated for the Project that is the subject of this Contract.

12. Federal Funds

As this Project is funded in whole or in part by federal funds, Contractor and all Subcontractors are subject to civil or criminal prosecution for any violation of the federal False Claims Act set forth under section 1001 of title 18 and section 231 of title 31 of the United States Code.

13. Separation of Documentation for Each Increment (Increment #1 and Increment #2)

Funding for the project comes from different funding sources; therefore, documentation must be separated by the two project Increments (Increment # 1 and Increment #2). This includes, but is not limited to, separation of the following items:

- (A) Applications for Payments
- (B) Change Order/Potential Change Orders (PCOs) Requests
- (C) Requests for Information (RFIs)
- (D) Submittals

14. Project Management Information System (PMIS)

The Contractor will be responsible to use the Project Management Information System (PMIS) supplied by the District as required. The PMIS will be used for all project documentation including but not limited to:

- (A) Applications for Payments
- (B) Change Order/Potential Change Orders (PCOs) Requests
- (C) Requests for Information (RFIs)
- (D) Submittals
- (E) Daily Logs
- (F) Meeting Minutes
- (G) Reports

15. Preliminary Schedule of Values

The preliminary schedule of values shall include, at a minimum, the following information and the following structure:

Replace provision in the General Conditions with the following provisions:

15.1.1.2.3. The preliminary schedule of values shall not provide for values any greater than the following percentages of the Contract value:

15.1.2.3.1 Mobilization and layout combined to equal not more than [1]%;

15.1.1.2.3.2 Submittals, samples and shop drawings combined to equal not more than [3]%;

15.1.1.2.3.3 Bonds and insurance combined to equal not more than [2]%.

The following provisions are added as Section 27:

27. FEDERAL LABOR, WAGE & HOUR, APPRENTICE, AND RELATED PROVISIONS

27.1 Minimum Wages

The Davis-Bacon Act and 29 CFR parts 1 through 7 shall apply if the Project is financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution.

27.1.1 All laborers and mechanics employed or working upon the Site of the Work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the Project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account, except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3) , the full amount

of wages and bona fide fringe benefits, or cash equivalents thereof, due at time of payment computed at rates not less than those contained in the applicable wage determination of the Secretary of Labor regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of this section, including but not limited to paragraph 27.1.7; also, regular contributions made or costs incurred for more than a weekly period, but not less often than quarterly, under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of Work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing Work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which Work is performed. The wage determination including any additional classification and wage rates conformed under this section, including but not limited to paragraph 27.1.6 and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its Subcontractors at the Site of the Work in a prominent and accessible place where it can be easily seen by the workers.

27.1.2 Any class of laborers or mechanics, including helpers, and which is to be employed under the Contract which is not listed in the wage determination shall be classified in conformance with the wage determination. An additional classification and wage rate and fringe benefits will not be approved unless when the following criteria have been met:

27.1.2.1 The Work to be performed by the classification requested is not performed by a classification in the wage determination; and

27.1.2.2 The classification is utilized in the area by the construction industry; and

27.1.2.3 The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

27.1.3 If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the District agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the Contractor to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210.

27.1.4 In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the District do not agree on the proposed classification and wage rate (including the amount designated for fringe

benefits, where appropriate), the Contractor shall provide the questions, including the views of all interested parties and the recommendation of the District, to the District for the District's review and referral to the Administrator for determination.

27.1.5 The wage rate (including fringe benefits where appropriate) determined pursuant to this section, shall be paid to all workers performing Work in the classification under this Contract from the first day on which Work is performed in the classification.

27.1.6 Whenever the minimum wage rate prescribed in any applicable wage determination for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

27.1.7 If the Contractor does not make payments to a trustee or other third person, the Contractor may consider, as part of the wages of any laborer or mechanic, the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. If the Secretary of Labor so requires, the Contractor shall set aside in a separate account sufficient assets to meet obligations under the plan or program.

27.2 Withholding. District may, upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this Contract or any other Federal contract with the same Contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any Subcontractor the full amount of wages required by the Contract. In the event of Contractor's or any Subcontractors' failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the Site of the Work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the Contract, the District may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as it deems necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

27.3 Payrolls and basic records.

27.3.1 Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the Work and preserved for a period of three years thereafter for all laborers and mechanics working at the Site of the Work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section

1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records that show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

27.3.2 The Contractor shall submit weekly for each week in which any Contract Work is performed a copy of all payrolls to the District. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information shall be submitted on a form acceptable to the District. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <https://www.dol.gov/whd/programs/dbra/wh347.htm> or its successor site. Contractor is responsible for the submission of copies of payrolls by all Subcontractors. Contractor and Subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the District, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. Contractor may require a Subcontractor to provide addresses and social security numbers to the Contractor for its own records, without weekly submission to the District or other government agency

27.3.3 Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or Subcontractor or his or her agent who pays or supervises the payment of the persons employed under the Contract and shall certify the following:

27.3.3.1 That the payroll for the payroll period contains the information required to be provided under 29 CFR 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5,

27.3.3.2 That the appropriate information is being maintained under 29 CFR 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and

27.3.3.3 That such information is correct and complete;

27.3.3.4 That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the Contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and

27.3.3.5 That no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

27.3.3.6 That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of Work performed, as specified in the applicable wage determination incorporated into or applicable to the Contract.

27.3.3.7 The weekly submission of a properly executed certification in the form set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 27.3.3 of this section.

27.3.3.8 The falsification of any of the above certifications may subject the Contractor or one or more Subcontractors to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

27.3.3.9 The Contractor or Subcontractor shall make the records required under this section available for inspection, copying, or transcription by authorized representatives of the District or the federal Department of Labor, and shall permit representatives to interview employees during working hours on the job. If the Contractor or Subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

27.4 Apprentices and trainees

27.4.1 Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the Work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first ninety (90) days of probationary employment as an apprentice in an eligible apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job Site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of Work actually performed. In addition, any apprentice performing Work on the job Site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the Work actually performed. Where a Contractor is

performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or Subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the Work performed until an acceptable program is approved.

27.4.2 Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to Work at less than the predetermined rate for the Work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job Site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of Work actually performed. In addition, any trainee performing Work on the job Site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the Work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the Work performed until an acceptable program is approved.

27.4.3 Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

27.5 Compliance with Copeland Act requirements. Contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this Contract.

27.6 Subcontracts. The Contractor or Subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the Federal agency may by appropriate instructions require, and also a clause requiring the Subcontractors to include these clauses in any lower tier subcontracts. The Contractor shall be responsible for the compliance by any Subcontractor or lower tier Subcontractor with all the Contract clauses in 29 CFR 5.5.

27.7 Contract termination: debarment. A breach of the Contract clauses in 29 CFR 5.5 may be grounds for termination of the Contract, and for debarment as a Contractor and a Subcontractor as provided in 29 CFR 5.12.

27.8 Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this Contract.

27.9 Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its Subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

27.10 Certification of eligibility.

27.10.1 By entering into this Contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

27.10.2 No part of this Contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

27.10.3 Contractor shall be subject to the penalty for making false statements prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

27.11 Clauses Mandated by Contract Work Hours and Safety Standards Act.

As used in the following paragraphs, the terms laborers and mechanics include watchmen and guards.

27.11.1 Overtime requirements. No Contractor or Subcontractor contracting for any part of the Contract Work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such Work to work in excess of forty

hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

27.11.2 Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in the foregoing paragraph the Contractor and any Subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and Subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the foregoing paragraph, in the sum of \$10 for each calendar day on which such individual was required or permitted to Work in excess of the standard workweek of forty hours without payment of the overtime wages required by the foregoing paragraph.

27.11.3 Withholding for unpaid wages and liquidated damages. The District may upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of Work performed by the Contractor or Subcontractor under the Contract or any other Federal contract with the same Contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or Subcontractor for unpaid wages and liquidated damages as provided in the foregoing paragraph.

27.11.4 Subcontracts. The Contractor or Subcontractor shall insert in any subcontracts the foregoing paragraphs concerning "Overtime requirements" and "Violation; liability for unpaid wages; liquidated damages" and also a clause requiring each Subcontractor to include these clauses in any lower tier subcontracts. Contractor shall be responsible for compliance by any Subcontractor or lower tier Subcontractor with the clauses set forth in paragraphs 27.11.1 through 27.11.4 of this section.

END OF DOCUMENT

DOCUMENT 00 73 56

HAZARDOUS MATERIALS
PROCEDURES & REQUIREMENTS

1. Summary

This document includes information applicable to hazardous materials and hazardous waste abatement.

2. Notice of Hazardous Waste or Materials

- a. Contractor shall give notice in writing to the District, the Construction Manager, and the Architect promptly, before any of the following materials are disturbed, and in no event later than twenty-four (24) hours after first observance, of any:
 - (1) Material that Contractor believes may be a material that is hazardous waste or hazardous material, as defined in section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law;
 - (2) Other material that may present a substantial danger to persons or property exposed thereto in connection with Work at the site.
- b. Contractor's written notice shall indicate whether the hazardous waste or material was shown or indicated in the Contract Documents to be within the scope of Work, and whether the materials were brought to the site by Contractor, its Subcontractors, suppliers, or anyone else for whom Contractor is responsible. As used in this section the term "hazardous materials" shall include, without limitation, asbestos, lead, Polychlorinated biphenyl (PCB), petroleum and related hydrocarbons, and radioactive material.
- c. In response to Contractor's written notice, the District shall investigate the identified conditions.
- d. If the District determines that conditions do not involve hazardous materials or that no change in terms of Contract is justified, the District shall so notify Contractor in writing, stating reasons. If the District and Contractor cannot agree on whether conditions justify an adjustment in Contract Price or Contract Time, or on the extent of any adjustment, Contractor shall proceed with the Work as directed by the District.
- e. If after receipt of notice from the District, Contractor does not agree to resume Work based on a reasonable belief it is unsafe, or does not agree to resume Work under special conditions, then District may order such portion of Work that is in connection with such hazardous condition or such affected area to be deleted from the Work, or performed by others, or District may invoke its rights to terminate the Contract in whole or in part. District will determine entitlement to or the amount or extent of an adjustment, if any, in

Contract Price or Contract Time as a result of deleting such portion of Work, or performing the Work by others.

- f. If Contractor stops Work in connection with any hazardous condition and in any area affected thereby, Contractor shall immediately redeploy its workers, equipment, and materials, as necessary, to other portions of the Work to minimize delay and disruption.

3. Additional Warranties and Representations

- a. Contractor represents and warrants that it, its employees, and its subcontractors and their employees, shall at all times have the required levels of familiarity with the Site and the Work, training, and ability to comply fully with all applicable laws and contractual requirements for safe and expeditious performance of the Work, including whatever training is or may be required regarding the activities to be performed (including, but not limited to, all training required to address adequately the actual or potential dangers of Contract performance).
- b. Contractor represents and warrants that it, its employees, and its subcontractors and their employees, shall at all times have and maintain in good standing any and all certifications and licenses required by applicable federal, state, and other governmental and quasi-governmental requirements applicable to the Work.
- c. Contractor represents and warrants that it has studied carefully all requirements of the Specifications regarding procedures for demolition, hazardous waste abatement, or safety practices, specified in the Contract, and prior to submitting its bid, has either (a) verified to its satisfaction that the specified procedures are adequate and sufficient to achieve the results intended by the Contract Documents, or (b) by way of approved "or equal" request or request for clarification and written Addenda, secured changes to the specified procedures sufficient to achieve the results intended by the Contract Documents. Contractor accepts the risk that any specified procedure will result in a completed Project in full compliance with the Contract Documents.

4. Monitoring and Testing

- a. District reserves the right, in its sole discretion, to conduct air monitoring, earth monitoring, Work monitoring, and any other tests (in addition to testing required under the agreement or applicable law), to monitor Contract requirements of safe and statutorily compliant work methods and (where applicable) safe re-entry level air standards under state and federal law upon completion of the job, and compliance of the work with periodic and final inspection by public and quasi-public entities having jurisdiction.
- b. Contractor acknowledges that District has the right to perform, or cause to be performed, various activities and tests including, but not limited to, pre-abatement, during abatement, and post-abatement air monitoring, that District shall have no obligation to perform said activities and tests, and that

a portion of said activities and tests may take place prior to the completion of the Work by Contractor. In the event District elects to perform these activities and tests, Contractor shall afford District ample access to the Site and all areas of the Work as may be necessary for the performance of these activities and tests. Contractor will include the potential impact of these activities or tests by District in the Contract Price and the Scheduled Completion Date.

- c. Notwithstanding District's rights granted by this paragraph, Contractor may retain its own industrial hygiene consultant at Contractor's own expense and may collect samples and may perform tests including, but not limited to, pre-abatement, during abatement, and post-abatement personal air monitoring, and District reserves the right to request documentation of all such activities and tests performed by Contractor relating to the Work and Contractor shall immediately provide that documentation upon request.

5. Compliance with Laws

- a. Contractor shall perform safe, expeditious, and orderly work in accordance with the best practices and the highest standards in the hazardous waste abatement, removal, and disposal industry, the applicable law, and the Contract Documents, including, but not limited to, all responsibilities relating to the preparation and return of waste shipment records, all requirements of the law, delivering of all requisite notices, and obtaining all necessary governmental and quasi-governmental approvals.
- b. Contractor represents that it is familiar with and shall comply with all laws applicable to the Work or completed Work including, but not limited to, all federal, state, and local laws, statutes, standards, rules, regulations, and ordinances applicable to the Work relating to:
 - (1) The protection of the public health, welfare and environment;
 - (2) Storage, handling, or use of asbestos, PCB, lead, petroleum based products, radioactive material, or other hazardous materials;
 - (3) The generation, processing, treatment, storage, transport, disposal, destruction, or other management of asbestos, PCB, lead, petroleum, radioactive material, or hazardous waste materials or other waste materials of any kind; and
 - (4) The protection of environmentally sensitive areas such as wetlands and coastal areas.

6. Disposal

- a. Contractor has the sole responsibility for determining current waste storage, handling, transportation, and disposal regulations for the job Site and for each waste disposal facility. Contractor must comply fully at its sole cost and expense with these regulations and any applicable law. District may, but is

not obligated to, require submittals with this information for it to review consistent with the Contract Documents.

- b. Contractor shall develop and implement a system acceptable to District to track hazardous waste from the Site to disposal, including appropriate "Hazardous Waste Manifests" on the EPA form, so that District may track the volume of waste it put in each landfill and receive from each landfill a certificate of receipt.
- c. Contractor shall provide District with the name and address of each waste disposal facility prior to any disposal, and District shall have the express right to reject any proposed disposal facility. Contractor shall not use any disposal facility to which District has objected. Contractor shall document actual disposal or destruction of waste at a designated facility by completing a disposal certificate or certificate of destruction forwarding the original to the District.

7. Permits

- a. Before performing any of the Work, and at such other times as may be required by applicable law, Contractor shall deliver all requisite notices and obtain the approval of all governmental and quasi-governmental authorities having jurisdiction over the Work. Contractor shall submit evidence satisfactory to District that it and any disposal facility:
 - (1) have obtained all required permits, approvals, and the like in a timely manner both prior to commencement of the Work and thereafter as and when required by applicable law; and
 - (2) are in compliance with all such permits, approvals and the regulations.

For example, before commencing any work in connection with the Work involving asbestos-containing materials, or PCBs, or other hazardous materials subject to regulation, Contractor agrees to provide the required notice of intent to renovate or demolish to the appropriate state or federal agency having jurisdiction, by certified mail, return receipt requested, or by some other method of transmittal for which a return receipt is obtained, and to send a copy of that notice to District. Contractor shall not conduct any Work involving asbestos-containing materials or PCBs unless Contractor has first confirmed that the appropriate agency having jurisdiction is in receipt of the required notification. All permits, licenses, and bonds that are required by governmental or quasi-governmental authorities, and all fees, deposits, tap fees, offsite easements, and asbestos and PCB disposal facilities expenses necessary for the prosecution of the Work, shall be procured and paid for by Contractor. Contractor shall give all notices and comply with the all applicable laws bearing on the conduct of the Work as drawn and specified. If Contractor observes or reasonably should have observed that Plans and Specifications and other Contract Documents are at variance therewith, it shall be responsible for promptly notifying District in writing of such fact. If

Contractor performs any Work contrary to applicable laws, it shall bear all costs arising therefrom.

- b. In the case of any permits or notices held in District's name or of necessity to be made in District's name, District shall cooperate with Contractor in securing the permit or giving the notice, but the Contractor shall prepare for District review and execution upon approval, all necessary applications, notices, and other materials.

8. Indemnification

To the fullest extent permitted by law, the indemnities and limitations of liability expressed throughout the Contract Documents apply with equal force and effect to any claims or liabilities imposed or existing by virtue of the removal, abatement, and disposal of hazardous waste. This includes, but is not limited to, liabilities connected to the selection and use of a waste disposal facility, a waste transporter, personal injury, property damage, loss of use of property, damage to the environment or natural resources, or "disposal" and "release" of materials associated with the Work (as defined in 42 U.S.C. § 9601 *et seq.*).

9. Termination

District shall have an absolute right to terminate for default immediately without notice and without an opportunity to cure should Contractor knowingly or recklessly commit a material breach of the terms of the Contract Documents, or any applicable law, on any matter involving the exposure of persons or property to hazardous waste. However, if the breach of contract exposing persons or property to hazardous waste is due solely to an ordinary, unintentional, and non-reckless failure to exercise reasonable care, then the procedures for termination for cause shall apply without modification.

END OF DOCUMENT

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE
MERRITT COMMUNITY COLLEGE CHILD CARE DEVELOPMENT CENTER

MITIGATION MONITORING AND REPORTING PROGRAM

Mitigation Measure	Party Responsible for Ensuring Implementation	Party Responsible for Monitoring	Monitoring Timing	Compliance Verification		
				Initial	Date	Project/ Comments
Air Quality						
<p><u>AIR-1:</u> During project construction, the contractor shall implement a dust control program that includes the following measures recommended by the Bay Area Air Quality Management District (BAAQMD) and these measures shall be included in contract specifications:</p> <ul style="list-style-type: none"> ▪ All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day. ▪ If any hauling activities would occur, all haul trucks transporting soil, sand, or other loose material off-site shall be covered. ▪ All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited. ▪ All vehicle speeds on unpaved roads shall be limited to 15 miles per hour. ▪ All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used. ▪ A publicly visible sign shall be posted with the telephone number and person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The BAAQMD phone number shall also be visible to ensure compliance with applicable regulations. <p>In addition, an independent construction monitor or a Peralta Community College District (PCCD) staff member shall conduct periodic site inspections, but in no event fewer than four total inspections, during the course of construction to ensure these mitigation measures are implemented and shall issue a letter report documenting the inspection results. Reports indicating non-compliance with construction mitigation measures shall be cause to issue a stop-work order until such time as compliance is achieved.</p>	District and Contractor	District	During construction			
Biological Resources						
<p><u>BIOLOGY-1:</u> Adequate measures shall be taken to avoid inadvertent take of raptor nests and other nesting birds protected under the Migratory Bird Treaty Act when in the nests are active use. This shall be accomplished by taking the following steps:</p> <ul style="list-style-type: none"> ▪ If construction is proposed during the nesting season (February through August), a focused survey for nesting raptors and other migratory birds shall be conducted by a 	District	District	Prior to construction			

Note: District = Peralta Community College District

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE
MERRITT COMMUNITY COLLEGE CHILD CARE DEVELOPMENT CENTER

MITIGATION MONITORING AND REPORTING PROGRAM

Mitigation Measure	Party Responsible for Ensuring Implementation	Party Responsible for Monitoring	Monitoring Timing	Compliance Verification		
				Initial	Date	Project/ Comments
<p>qualified biologist within 14 days prior to the onset of tree removal or construction, in order to identify any active nests on the project site and in the vicinity of proposed construction.</p> <ul style="list-style-type: none"> ▪ If no active nests are identified during the survey period, or if development is initiated during the non-breeding season (September through February), construction may proceed with no restrictions. ▪ If bird nests are found, an adequate setback shall be established around the nest location and construction activities restricted within this no-disturbance zone until the qualified biologist has confirmed that any young birds have fledged and are able to function outside the nest location. Required setback distances for the no-disturbance zone shall be based on input received from the California Department of Fish and Wildlife (CDFW), and may vary depending on species and sensitivity to disturbance. As necessary, the no-disturbance zone shall be fenced with temporary orange construction fencing if construction is to be initiated on the remainder of the construction area. ▪ A report of findings shall be prepared by the qualified biologist and submitted to the Peralta Community College District (PCCD) for review and approval prior to initiation of construction within the no-disturbance zone during the nesting season (February through August). The report either shall confirm absence of any active nests or shall confirm that any young within a designated no-disturbance zone have fledged and construction can proceed. <p>Implementation of Mitigation Measure BIOLOGY-1 would reduce potentially significant impacts on nesting birds to a less-than-significant level.</p>						
Cultural Resources						
<p><u>CULTURAL-1</u>: Should an archaeological deposit be encountered during project subsurface construction activities, all ground-disturbing activities within 25 feet shall be redirected and a qualified archaeologist meeting the Secretary of the Interior’s Professional Qualifications Standards for Archeology contacted to assess the situation, determine if the deposit qualifies as a historical resource, consult with agencies as appropriate, and make recommendations for the treatment of the discovery. If the deposit is found to be significant (i.e., eligible for listing in the California Register of Historical Resources), the Peralta Community College District (PCCD) shall be responsible for funding and implementing appropriate mitigation measures. Mitigation measures may include recording of the archaeological deposit, data recovery and analysis, and public outreach regarding the scientific and cultural importance of the discovery. Upon completion of the selected mitigations, a report documenting methods, findings, and recommendations shall be</p>	District	District	Prior to and during construction			

Note: District = Peralta Community College District

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE
MERRITT COMMUNITY COLLEGE CHILD CARE DEVELOPMENT CENTER

MITIGATION MONITORING AND REPORTING PROGRAM

Mitigation Measure	Party Responsible for Ensuring Implementation	Party Responsible for Monitoring	Monitoring Timing	Compliance Verification		
				Initial	Date	Project/ Comments
<p>prepared and submitted to the PCCD for review, and the final report shall be submitted to the Northwest Information Center at Sonoma State University. Significant archaeological materials shall be submitted to an appropriate local curation facility and used for future research and public interpretive displays, as appropriate.</p> <p>The PCCD shall inform its contractor(s) of the sensitivity of the project area for archaeological deposits and shall verify that the following directive has been included in the appropriate contract documents:</p> <p>“The subsurface of the construction site may be sensitive for Native American archaeological deposits and associated human remains. If archaeological deposits are encountered during project subsurface construction, all ground-disturbing activities within 25 feet shall stop and a qualified archaeologist contacted to assess the situation and make recommendations for the treatment of the discovery. Project personnel shall not collect or move any archaeological materials. Archaeological deposits can include shellfish remains; bones; flakes of, and tools made from, obsidian, chert, and basalt; and mortars and pestles. Contractor acknowledges and understands that excavation or removal of archaeological material is prohibited by law and constitutes a misdemeanor under California Public Resources Code, Section 5097.5 and breach of contract.”</p> <p>With implementation of the above mitigation measure, the potential impact on historical and archaeological resources would be reduced to a less-than-significant level.</p>						
<u>CULTURAL-2</u> : Mitigation Measure CULTURAL-1 shall be implemented.	District	District	Prior to and during construction			
Hazards and Hazardous Materials						
<u>HAZARDS-1a</u> : Construction contractors shall ensure the following measures are implemented to minimize the potential for accidental ignition of construction materials and vegetation: 1) flammable/combustible materials shall be stored away from vegetated areas; 2) spark arrestors shall be fitted on all construction vehicles and equipment; 3) work that generates sparks such metal cutting, torching, and welding shall only be performed in areas where vegetation has been sufficiently cleared and the ground surface has been wetted; and 4) an adequate water source and fire extinguishers shall be available at all times for fire suppression.	District and construction contractors	District	During construction			
<u>HAZARDS-1b</u> : The Peralta Community College District (PCCD) shall develop a Vegetation Management and Fire Prevention Plan prior to the start of construction, and shall implement the plan during construction and operation of the project. The Vegetation Management and Fire Prevention Plan shall include, at a minimum, the following	District	District	Prior to construction and during construction and operation of project			

Note: District = Peralta Community College District

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE
MERRITT COMMUNITY COLLEGE CHILD CARE DEVELOPMENT CENTER

MITIGATION MONITORING AND REPORTING PROGRAM

Mitigation Measure	Party Responsible for Ensuring Implementation	Party Responsible for Monitoring	Monitoring Timing	Compliance Verification		
				Initial	Date	Project/ Comments
measures:						
<ul style="list-style-type: none"> ▪ Using spark arrestors on all vehicles and equipment used for vegetation management; ▪ Using fire-resistant plants when planting areas for erosion control; ▪ Pruning the lower branches of tall trees; ▪ Clearing out ground-level brush and debris; and ▪ Storing combustible materials away from vegetated areas. 						
Implementation of Mitigation Measures HAZARDS-1a and HAZARDS-1b would ensure that the proposed project would result in less-than-significant impacts related to wildfires.						
Noise						
<u>NOISE-1a</u> : The Peralta Community College District (PCCD) shall require the construction contractor to develop a set of procedures for tracking and responding to complaints received pertaining to construction vibration and noise and implement the procedures during construction. At a minimum, the procedures shall include:	District and contractor	District	Prior to and during construction			
<ol style="list-style-type: none"> 1. Designation of an on-site construction complaint and enforcement manager for the project; 2. Protocols specific to on-campus and off-campus receptors for receiving, responding to, and tracking received complaints; and 3. Maintenance of a complaint log that records received complaints and how complaints were addressed. 						
<u>NOISE-1b</u> : Nearby residents, college students, and staff shall be informed of construction activity through informational notices posted on the fence line of the construction site, nearby buildings, and classrooms. The notices shall state the date of planned construction activity and include the contact information of the construction complaint and enforcement manager identified in Mitigation Measure NOISE-1a.	District	District	Prior to construction			
<u>NOISE-1c</u> : To the maximum extent practicable, the construction contractor shall coordinate construction activities so that noisier construction activities do not occur during established testing periods (e.g., finals week).	District and contractor	District	Prior to and during construction			
<u>NOISE-1d</u> : For all project construction activities, the PCCD shall require the construction contractor to implement measures to reduce noise impacts related to construction. Noise reduction measures include, but are not limited to, the following:	District and contractor	District	During construction			
<ol style="list-style-type: none"> 1. Equipment and trucks used for project construction shall use reasonable noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, 						

Note: District = Peralta Community College District

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE
MERRITT COMMUNITY COLLEGE CHILD CARE DEVELOPMENT CENTER

MITIGATION MONITORING AND REPORTING PROGRAM

Mitigation Measure	Party Responsible for Ensuring Implementation	Party Responsible for Monitoring	Monitoring Timing	Compliance Verification		
				Initial	Date	Project/ Comments
ducts, engine enclosures and acoustically-attenuating shields or shrouds), wherever feasible.						
2. Except as provided herein, impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for project construction shall, to the extent feasible, be hydraulically or electrically powered to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used, if such jackets are commercially available; this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, to the extent feasible, whenever such procedures are available and consistent with required construction procedures. These recommendations shall be included in contract specifications.						
3. To the extent feasible, stationary noise sources shall be located as far from nearby receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures to provide reasonably equivalent noise reduction as feasible.						
The combination of the above mitigation measures would reduce the impact to a less-than-significant level.						
<u>NOISE-2:</u> Mitigation Measures NOISE-1a, NOISE-1b, NOISE-1c, and NOISE-1d shall be implemented.	District	District	Prior to and during construction			
The above mitigation measures would require the development of a noise complaint tracking and response system; notification to nearby students and staff of planned construction activities; construction to be scheduled to avoid disrupting established testing periods scheduled at Building E, as feasible; and the implementation of measures to reduce noise generated by construction to the maximum extent feasible. These measures are relevant because high noise-generating construction activities often generate high vibration levels. These measures would reduce the potential vibration impact to a less-than-significant level.						

Note: District = Peralta Community College District

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE
MERRITT COMMUNITY COLLEGE CHILD CARE DEVELOPMENT CENTER

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Note: District = Peralta Community College District

DOCUMENT 01 29 00

**APPLICATION FOR PAYMENT AND
CONDITIONAL AND UNCONDITIONAL WAIVER AND RELEASE FORMS**

**CONTRACTOR SHALL COMPLY WITH ALL PROVISIONS IN THE GENERAL
CONDITIONS AND SPECIAL CONDITIONS RELATED TO APPLICATIONS FOR
PAYMENT AND/OR PAYMENTS.**

AE3 Partners
DSA Application No. 01-119166
September 7, 2021

Increment 1
01 2900 - 1

Merritt College
Child Development Center
APPLICATION FOR PAYMENT AND
CONDITIONAL AND UNCONDITIONAL WAIVER
AND RELEASE FORMS

**CONDITIONAL WAIVER AND RELEASE
ON PROGRESS PAYMENT
(CIVIL CODE SECTION 8132)**

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Through Date: _____

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: _____

Amount of Check: \$ _____

Check Payable to: _____

Exceptions

This document does not affect any of the following:

- (1) Retentions.
- (2) Extras for which the claimant has not received payment.
- (3) The following progress payments for which the claimant has previously given a conditional waiver and release but has not received payment:

Date(s) of waiver and release: _____

Amount(s) of unpaid progress payment(s): \$ _____

- (4) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

**UNCONDITIONAL WAIVER AND RELEASE
ON PROGRESS PAYMENT
(CIVIL CODE SECTION 8134)**

NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Through Date: _____

Unconditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has received the following progress payment: \$_____

Exceptions

This document does not affect any of the following:

- (1) Retentions.
- (2) Extras for which the claimant has not received payment.
- (3) Contract rights, including (A) a right based on rescission, abandonment, or breach of contract, and (B) the right to recover compensation for work not compensated by the payment.

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

**CONDITIONAL WAIVER AND RELEASE
ON FINAL PAYMENT
(CIVIL CODE SECTION 8136)**

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check:

Amount of Check: \$ _____

Check Payable to: _____

Exceptions

This document does not affect any of the following: _____

Disputed claims for extras in the amount of: \$ _____

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

**UNCONDITIONAL WAIVER AND RELEASE
ON FINAL PAYMENT**
(CIVIL CODE SECTION 8138)

NOTICE TO CLAIMANT: THIS DOCUMENT WAIVES AND RELEASES LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL WAIVER AND RELEASE FORM.

Name of Claimant: _____

Name of Customer: _____

Job Location: _____

Owner: _____

Unconditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for all labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. The claimant has been paid in full.

Exceptions

This document does not affect any of the following: _____

Disputed claims for extras in the amount of: \$ _____

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

DOCUMENT 01 31 19

PROJECT MEETINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions; and
- B. Special Conditions.

1.02 PROGRESS MEETINGS:

- A. Contractor shall schedule and hold regular weekly progress meetings after a minimum of one week's prior written notice of the meeting date and time to all Invitees as indicated below.
- B. Location: Contractor's field office.
- C. The Contractor shall notify and invite the following entities ("Invitees"):
 - (1) District Representative.
 - (2) Contractor.
 - (3) Contractor's Project Manager.
 - (4) Contractor's Superintendent.
 - (5) Subcontractors, as appropriate to the agenda of the meeting.
 - (6) Suppliers, as appropriate to the agenda of the meeting.
 - (7) Construction Manager, if any.
 - (8) Architect
 - (9) Engineer(s), if any and as appropriate to the agenda of the meeting.
 - (10) Others, as appropriate to the agenda of the meeting.
- D. The District's, the Architect's, and/or an engineer's Consultants will attend at their discretion, in response to the agenda.
- E. The District representative, the Construction Manager, and/or another District Agent shall take and distribute meeting notes to attendees and other concerned parties. If exceptions are taken to anything in the meeting notes,

those exceptions shall be stated in writing to the District within five (5) working days following District's distribution of the meeting notes.

1.03 PRE-INSTALLATION/PERFORMANCE MEETING:

- A. Contractor shall schedule a meeting prior to the start of each of the following portions of the Work: cutting and patching of plaster and roofing, and other weather-exposed and moisture-resistant products. Contractor shall invite all Invitees to this meeting, and others whose work may affect or be affected by the quality of the cutting and patching work.
- B. Contractor shall review in detail prior to this meeting, the manufacturer's requirements and specifications, applicable portions of the Contract Documents, Shop Drawings, and other submittals, and other related work. At this meeting, invitees shall review and resolve conflicts, incompatibilities, or inadequacies discovered or anticipated.
- C. Contractor shall review in detail Project conditions, schedule, requirements for performance, application, installation, and quality of completed Work, and protection of adjacent Work and property.
- D. Contractor shall review in detail means of protecting the completed Work during the remainder of the construction period.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 32 13

SCHEDULING OF WORK**PART 1 – GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions;
- C. Summary of Work; and
- D. Submittals.

1.02 SECTION INCLUDES

- A. Scheduling of Work under this Contract shall be performed by Contractor in accordance with requirements of this Section.
 - (1) Development of schedule, cost and resource loading of the schedule, monthly payment requests, and project status reporting requirements of the Contract shall employ computerized Critical Path Method ("CPM") scheduling ("CPM Schedule").
 - (2) CPM Schedule shall be cost loaded based on Schedule of Values as approved by District.
 - (3) Submit schedules and reports as specified in the General Conditions.
- B. Upon Award of Contract, Contractor shall immediately commence development of Initial and Original CPM Schedules to ensure compliance with CPM Schedule submittal requirements.

1.03 CONSTRUCTION SCHEDULE

- A. Within ten (10) days of issuance of the Notice to Proceed, and before request for first progress payment, the Contractor shall prepare and submit to the Project Manager a construction progress schedule conforming to the Milestone Schedule below.
- B. The Construction Schedule shall be continuously updated, and an updated schedule shall be submitted with each application for progress payment. Each revised schedule shall indicate the work actually accomplished during the previous period and the schedule for completion of the remaining work.

C. Milestone Schedule:

ACTIVITY DESCRIPTION	DURATION
ALL SUBMITTALS PROVIDED	WITHIN 90 CALENDAR DAYS OF NTP
SLAB-ON-GRADE COMPLETE	WITHIN 180 CALENDAR DAYS OF NTP
BUILDING WEATHER TIGHT	WITHIN 365 CALENDAR DAYS OF NTP
SUBSTANTIAL PROJECT COMPLETION	WITHIN 510 CALENDAR DAYS OF NTP
FINAL PROJECT COMPLETION	WITHIN 540 CALENDAR DAYS OF NTP

1.04 QUALIFICATIONS

- A. Contractor shall employ experienced scheduling personnel qualified to use the latest version of [i.e., Primavera Project Planner]. Experience level required is set forth below. Contractor may employ such personnel directly or may employ a consultant for this purpose.
 - (1) The written statement shall identify the individual who will perform CPM scheduling.
 - (2) Capability and experience shall be verified by description of construction projects on which individual has successfully applied computerized CPM.
 - (3) Required level of experience shall include at least two (2) projects of similar nature and scope with value not less than three fourths (¾) of the Total Bid Price of this Project. The written statement shall provide contact persons for referenced projects with current telephone and address information.
- B. District reserves the right to approve or reject Contractor’s scheduler or consultant at any time. District reserves the right to refuse replacing of Contractor’s scheduler or consultant, if District believes replacement will negatively affect the scheduling of Work under this Contract.

1.05 GENERAL

- A. Progress Schedule shall be based on and incorporate milestone and completion dates specified in Contract Documents.
- B. Overall time of completion and time of completion for each milestone shown on Progress Schedule shall adhere to times in the Contract, unless an earlier (advanced) time of completion is requested by Contractor and agreed to by District. Any such agreement shall be formalized by a Change Order.
 - (1) District is not required to accept an early completion schedule, i.e., one that shows an earlier completion date than the Contract Time.
 - (2) Contractor shall not be entitled to extra compensation in event agreement is reached on an earlier completion schedule and Contractor completes its Work, for whatever reason, beyond

completion date shown in its early completion schedule but within the Contract Time.

- (3) A schedule showing the work completed in less than the Contract Time, and that has been accepted by District, shall be considered to have Project Float. The Project Float is the time between the scheduled completion of the work and the Completion Date. Project Float is a resource available to both District and the Contractor.
- C. Ownership Project Float: Neither the District nor Contractor owns Project Float. The Project owns the Project Float. As such, liability for delay of the Completion Date rests with the party whose actions, last in time, actually cause delay to the Completion Date.
- (1) For example, if Party A uses some, but not all of the Project Float and Party B later uses remainder of the Project Float as well as additional time beyond the Project Float, Party B shall be liable for the time that represents a delay to the Completion Date.
 - (2) Party A would not be responsible for the time since it did not consume the entire Project Float and additional Project Float remained; therefore, the Completion Date was unaffected by Party A.
- D. Progress Schedule shall be the basis for evaluating job progress, payment requests, and time extension requests. Responsibility for developing Contract CPM Schedule and monitoring actual progress as compared to Progress Schedule rests with Contractor.
- E. Failure of Progress Schedule to include any element of the Work, or any inaccuracy in Progress Schedule, will not relieve Contractor from responsibility for accomplishing the Work in accordance with the Contract. District's acceptance of schedule shall be for its use in monitoring and evaluating job progress, payment requests, and time extension requests and shall not, in any manner, impose a duty of care upon District, or act to relieve Contractor of its responsibility for means and methods of construction.
- F. Software: Use the latest version of Primavera P6 and Microsoft Project. Such software shall be compatible with Windows operating system. Contractor shall transmit contract file to District on compact disk at times requested by District.
- G. Transmit each item under the form approved by District.
- (1) Identify Project with District Contract number and name of Contractor.
 - (2) Provide space for Contractor's approval stamp and District's review stamps.
 - (3) Submittals received from sources other than Contractor will be returned to the Contractor without District's review.

1.06 INITIAL CPM SCHEDULE

- A. Initial CPM Schedule submitted for review at the pre-construction conference shall serve as Contractor’s schedule for up to ninety (90) calendar days after the Notice to Proceed.
- B. Indicate detailed plan for the Work to be completed in first ninety (90) days of the Contract; details of planned mobilization of plant and equipment; sequence of early operations; procurement of materials and equipment. Show Work beyond ninety (90) calendar days in summary form.
- C. Initial CPM Schedule shall be time scaled.
- D. Initial CPM Schedule shall be cost and resource loaded. Accepted cost and resource loaded schedule will be used as basis for monthly progress payments until acceptance of the Original CPM Schedule. Use of Initial CPM Schedule for progress payments shall not exceed ninety (90) calendar days.
- E. District and Contractor shall meet to review and discuss the Initial CPM Schedule within seven (7) calendar days after it has been submitted to District.
 - (1) District’s review and comment on the schedule shall be limited to Contract conformance (with sequencing, coordination, and milestone requirements).
 - (2) Contractor shall make corrections to schedule necessary to comply with Contract requirements and shall adjust schedule to incorporate any missing information requested by District. Contractor shall resubmit Initial CPM Schedule if requested by District.
- F. If, during the first ninety (90) days after Notice to Proceed, the Contractor is of the opinion that any of the Work included on its Initial CPM Schedule has been impacted, the Contractor shall submit to District a written Time Impact Evaluation (“TIE”) in accordance with Article 1.12 of this Section. The TIE shall be based on the most current update of the Initial CPM Schedule.

1.07 ORIGINAL CPM SCHEDULE

- A. Submit a detailed proposed Original CPM Schedule presenting an orderly and realistic plan for completion of the Work in conformance with requirements as specified herein.
- B. Progress Schedule shall include or comply with following requirements:
 - (1) Time scaled, cost and resource (labor and major equipment) loaded CPM schedule.
 - (2) No activity on schedule shall have duration longer than fifteen (15) work days, with exception of submittal, approval, fabrication and procurement activities, unless otherwise approved by District.

- (a) Activity durations shall be total number of actual work days required to perform that activity.
- (3) The start and completion dates of all items of Work, their major components, and milestone completion dates, if any.
- (4) District furnished materials and equipment, if any, identified as separate activities.
- (5) Activities for maintaining Project Record Documents.
- (6) Dependencies (or relationships) between activities.
- (7) Processing/approval of submittals and shop drawings for all material and equipment required per the Contract. Activities that are dependent on submittal acceptance or material delivery shall not be scheduled to start earlier than expected acceptance or delivery dates.
 - (a) Include time for submittals, re-submittals and reviews by District. Coordinate with accepted schedule for submission of Shop Drawings, samples, and other submittals.
 - (b) Contractor shall be responsible for all impacts resulting from re-submittal of Shop Drawings and submittals.
- (8) Procurement of major equipment, through receipt and inspection at jobsite, identified as separate activity.
 - (a) Include time for fabrication and delivery of manufactured products for the Work.
 - (b) Show dependencies between procurement and construction.
- (9) Activity description; what Work is to be accomplished and where.
- (10) The total cost of performing each activity shall be total of labor, material, and equipment, excluding overhead and profit of Contractor. Overhead and profit of the General Contractor shall be shown as a separate activity in the schedule. Sum of cost for all activities shall equal total Contract value.
- (11) Resources required (labor and major equipment) to perform each activity.
- (12) Responsibility code for each activity corresponding to Contractor or Subcontractor responsible for performing the Work.
- (13) Identify the activities which constitute the controlling operations or critical path. No more than twenty-five (25%) of the activities shall be critical or near critical. Near critical is defined as float in the range of one (1) to (10) days.

- (14) Twenty (20) workdays for developing punch list(s), completion of punch-list items, and final clean-up for the Work or any designated portion thereof. No other activities shall be scheduled during this period.
- (15) Interface with the work of other contractors, District, and agencies such as, but not limited to, utility companies.
- (16) Show detailed Subcontractor Work activities. In addition, furnish copies of Subcontractor schedules upon which CPM was built.
 - (a) Also furnish for each Subcontractor, as determined by District, submitted on Subcontractor letterhead, a statement certifying that Subcontractor concurs with Contractor's Original CPM Schedule and that Subcontractor's related schedules have been incorporated, including activity duration, cost and resource loading.
 - (b) Subcontractor schedules shall be independently derived and not a copy of Contractor's schedule.
 - (c) In addition to Contractor's schedule and resource loading, obtain from electrical, mechanical, and plumbing Subcontractors, and other Subcontractors as required by District, productivity calculations common to their trades, such as units per person day, feet of pipe per day per person, feet of wiring per day per person, and similar information.
 - (d) Furnish schedule for Contractor/Subcontractor CPM schedule meetings which shall be held prior to submission of Original CPM schedule to District. District shall be permitted to attend scheduled meetings as an observer.
- (17) Activity durations shall be in Work days.
- (18) Submit with the schedule a list of anticipated non-Work days, such as weekends and holidays. The Progress Schedule shall exclude in its Work day calendar all non-Work days on which Contractor anticipates critical Work will not be performed.

C. Original CPM Schedule Review Meeting: Contractor shall, within sixty (60) days from the Notice to Proceed date, meet with District to review the Original CPM Schedule submittal.

- (1) Contractor shall have its Project Manager, Project Superintendent, Project Scheduler, and key Subcontractor representatives, as required by District, in attendance. The meeting will take place over a continuous one (1) day period.
- (2) District's review will be limited to submittal's conformance to Contract requirements including, but not limited to, coordination requirements. However, review may also include:

- (a) Clarifications of Contract Requirements.
 - (b) Directions to include activities and information missing from submittal.
 - (c) Requests to Contractor to clarify its schedule.
- (3) Within five (5) days of the Schedule Review Meeting, Contractor shall respond in writing to all questions and comments expressed by District at the Meeting.

1.08 ADJUSTMENTS TO CPM SCHEDULE

- A. Adjustments to Original CPM Schedule: Contractor shall have adjusted the Original CPM Schedule submittal to address all review comments from original CPM Schedule review meeting and resubmit network diagrams and reports for District’s review.
- (1) District, within ten (10) days from date that Contractor submitted the revised schedule, will either:
 - (a) Accept schedule and cost and resource loaded activities as submitted, or
 - (b) Advise Contractor in writing to review any part or parts of schedule which either do not meet Contract requirements or are unsatisfactory for District to monitor Project’s progress, resources, and status or evaluate monthly payment request by Contractor.
 - (2) District may accept schedule with conditions that the first monthly CPM Schedule update be revised to correct deficiencies identified.
 - (3) When schedule is accepted, it shall be considered the “Original CPM Schedule” which will then be immediately updated to reflect the current status of the work.
 - (4) District reserves right to require Contractor to adjust, add to, or clarify any portion of schedule which may later be discovered to be insufficient for monitoring of Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.
- B. Acceptance of Contractor’s schedule by District will be based solely upon schedule’s compliance with Contract requirements.
- (1) By way of Contractor assigning activity durations and proposing sequence of Work, Contractor agrees to utilize sufficient and necessary management and other resources to perform work in accordance with the schedule.

- (2) Upon submittal of schedule update, updated schedule shall be considered "current" CPM Schedule.
- (3) Submission of Contractor's schedule to District shall not relieve Contractor of total responsibility for scheduling, sequencing, and pursuing Work to comply with requirements of Contract Documents, including adverse effects such as delays resulting from ill-timed Work.
- C. Submittal of Original CPM Schedule, and subsequent schedule updates, shall be understood to be Contractor's representation that the Schedule meets requirements of Contract Documents and that Work shall be executed in sequence indicated on the schedule.
- D. Contractor shall distribute Original CPM Schedule to Subcontractors for review and written acceptance, which shall be noted on Subcontractors' letterheads to Contractor and transmitted to District for the record.

1.09 MONTHLY CPM SCHEDULE UPDATE SUBMITTALS

- A. Following acceptance of Contractor's Original CPM Schedule, Contractor shall monitor progress of Work and adjust schedule each month to reflect actual progress and any anticipated changes to planned activities.
 - (1) Each schedule update submitted shall be complete, including all information requested for the Original CPM Schedule submittal.
 - (2) Each update shall continue to show all Work activities including those already completed. These completed activities shall accurately reflect "as built" information by indicating when activities were actually started and completed.
- B. A meeting will be held on approximately the twenty-fifth (25th) of each month to review the schedule update submittal and progress payment application.
 - (1) At this meeting, at a minimum, the following items will be reviewed: Percent (%) complete of each activity; Time Impact Evaluations for Change Orders and Time Extension Request; actual and anticipated activity sequence changes; actual and anticipated duration changes; and actual and anticipated Contractor delays.
 - (2) These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, these meetings shall be attended by Contractor's General Superintendent and Scheduler.
 - (3) Contractor shall plan on the meeting taking no less than four (4) hours.
- C. Within five (5) working days after monthly schedule update meeting, Contractor shall submit the updated CPM Schedule update.

- D. Within five (5) work days of receipt of above noted revised submittals, District will either accept or reject monthly schedule update submittal.
 - (1) If accepted, percent (%) complete shown in monthly update will be basis for Application for Payment by the Contractor. The schedule update shall be submitted as part of the Contractor's Application for Payment.
 - (2) If rejected, update shall be corrected and resubmitted by Contractor before the Application for Payment is submitted.
- E. Neither updating, changing or revising of any report, curve, schedule, or narrative submitted to District by Contractor under this Contract, nor District's review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying in any way the Completion Date or milestone dates or of modifying or limiting in any way Contractor's obligations under this Contract.

1.10 SCHEDULE REVISIONS

- A. Updating the Schedule to reflect actual progress shall not be considered revisions to the Schedule. Since scheduling is a dynamic process, revisions to activity durations and sequences are expected on a monthly basis.
- B. To reflect revisions to the Schedule, the Contractor shall provide District with a written narrative with a full description and reasons for each Work activity revised. For revisions affecting the sequence of work, the Contractor shall provide a schedule diagram which compares the original sequence to the revised sequence of work. The Contractor shall provide the written narrative and schedule diagram for revisions two (2) working days in advance of the monthly schedule update meeting.
- C. Schedule revisions shall not be incorporated into any schedule update until the revisions have been reviewed by District. District may request further information and justification for schedule revisions and Contractor shall, within three (3) days, provide District with a complete written narrative response to District's request.
- D. If the Contractor's revision is still not accepted by District, and the Contractor disagrees with District's position, the Contractor has seven (7) calendar days from receipt of District's letter rejecting the revision to provide a written narrative providing full justification and explanation for the revision. The Contractor's failure to respond in writing within seven (7) calendar days of District's written rejection of a schedule revision shall be contractually interpreted as acceptance of District's position, and the Contractor waives its rights to subsequently dispute or file a claim regarding District's position.
- E. At District's discretion, the Contractor can be required to provide Subcontractor certifications of performance regarding proposed schedule revisions affecting said Subcontractors.

1.11 RECOVERY SCHEDULE

- A. If the Schedule Update shows a completion date twenty-one (21) calendar days beyond the Contract Completion Date, or individual milestone completion dates, the Contractor shall submit to District the proposed revisions to recover the lost time within seven (7) calendar days. As part of this submittal, the Contractor shall provide a written narrative for each revision made to recapture the lost time. If the revisions include sequence changes, the Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of work.
- B. The revisions shall not be incorporated into any schedule update until the revisions have been reviewed by District.
- C. If the Contractor's revisions are not accepted by District, District and the Contractor shall follow the procedures in paragraph 1.09.C, 1.09.D and 1.09.E above.
- D. At District's discretion, the Contractor can be required to provide Subcontractor certifications for revisions affecting said Subcontractors.

1.12 TIME IMPACT EVALUATION ("TIE") FOR CHANGE ORDERS, AND OTHER DELAYS

- A. When Contractor is directed to proceed with changed Work, the Contractor shall prepare and submit within fourteen (14) calendar days from the Notice to Proceed a TIE which includes both a written narrative and a schedule diagram depicting how the changed Work affects other schedule activities. The schedule diagram shall show how the Contractor proposes to incorporate the changed Work in the schedule and how it impacts the current schedule-update critical path. The Contractor is also responsible for requesting time extensions based on the TIE's impact on the critical path. The diagram must be tied to the main sequence of schedule activities to enable District to evaluate the impact of changed Work to the scheduled critical path.
- B. Contractor shall be required to comply with the requirements of Paragraph 1.09.A for all types of delays such as, but not limited to, Contractor/Subcontractor delays, adverse weather delays, strikes, procurement delays, fabrication delays, etc.
- C. Contractor shall be responsible for all costs associated with the preparation of TIEs, and the process of incorporating them into the current schedule update. The Contractor shall provide District with four (4) copies of each TIE.
- D. Once agreement has been reached on a TIE, the Contract Time will be adjusted accordingly. If agreement is not reached on a TIE, the Contract Time may be extended in an amount District allows, and the Contractor may submit a claim for additional time claimed by contractor.

1.13 TIME EXTENSIONS

- A. The Contractor is responsible for requesting time extensions for time impacts that, in the opinion of the Contractor, impact the critical path of the current schedule update. Notice of time impacts shall be given in accord with the General Conditions.
- B. Where an event for which District is responsible impacts the projected Completion Date, the Contractor shall provide a written mitigation plan, including a schedule diagram, which explains how (e.g., increase crew size, overtime, etc.) the impact can be mitigated. The Contractor shall also include a detailed cost breakdown of the labor, equipment, and material the Contractor would expend to mitigate District-caused time impact. The Contractor shall submit its mitigation plan to District within fourteen (14) calendar days from the date of discovery of the impact. The Contractor is responsible for the cost to prepare the mitigation plan.
- C. Failure to request time, provide TIE, or provide the required mitigation plan will result in Contractor waiving its right to a time extension and cost to mitigate the delay.
- D. No time will be granted under this Contract for cumulative effect of changes.
- E. District will not be obligated to consider any time extension request unless the Contractor complies with the requirements of Contract Documents.
- F. Failure of the Contractor to perform in accordance with the current schedule update shall not be excused by submittal of time extension requests.
- G. If the Contractor does not submit a TIE within the required fourteen (14) calendar days for any issue, it is mutually agreed that the Contractor does not require a time extension for said issue.

1.14 SCHEDULE REPORTS

- A. Submit four (4) copies of the following reports with the Initial CPM Schedule, the Original CPM Schedule, and each monthly update.
- B. Required Reports:
 - (1) Two activity listing reports: one sorted by activity number and one by total Project Float. These reports shall also include each activity's early/late and actual start and finish dates, original and remaining duration, Project Float, responsibility code, and the logic relationship of activities.
 - (2) Cost report sorted by activity number including each activity's associated cost, percentage of Work accomplished, earned value- to date, previous payments, and amount earned for current update period.

- (3) Schedule plots presenting time-scaled network diagram showing activities and their relationships with the controlling operations or critical path clearly highlighted.
- (4) Cash flow report calculated by early start, late start, and indicating actual progress. Provide an exhibit depicting this information in graphic form.
- (5) Planned versus actual resource (i.e., labor) histogram calculated by early start and late start.

C. Other Reports:

In addition to above reports, District may request, from month to month, any two of the following reports. Submit four (4) copies of all reports.

- (1) Activities by early start.
- (2) Activities by late start.
- (3) Activities grouped by Subcontractors or selected trades.
- (4) Activities with scheduled early start dates in a given time frame, such as fifteen (15) or thirty (30) day outlook.

D. Furnish District with report files on compact disks containing all schedule files for each report generated.

1.15 PROJECT STATUS REPORTING

- A. In addition to submittal requirements for CPM scheduling identified in this Section, Contractor shall provide a monthly project status report (i.e., written narrative report) to be submitted in conjunction with each CPM Schedule as specified herein. Status reporting shall be in form specified below.
- B. Contractor shall prepare monthly written narrative reports of status of Project for submission to District. Written status reports shall include:
 - (1) Status of major Project components (percent (%) complete, amount of time ahead or behind schedule) and an explanation of how Project will be brought back on schedule if delays have occurred.
 - (2) Progress made on critical activities indicated on CPM Schedule.
 - (3) Explanations for any lack of work on critical path activities planned to be performed during last month.
 - (4) Explanations for any schedule changes, including changes to logic or to activity durations.
 - (5) List of critical activities scheduled to be performed next month.

- (6) Status of major material and equipment procurement.
- (7) Any delays encountered during reporting period.
- (8) Contractor shall provide printed report indicating actual versus planned resource loading for each trade and each activity. This report shall be provided on weekly and monthly basis.
 - (a) Actual resource shall be accumulated in field by Contractor, and shall be as noted on Contractor's daily reports. These reports will be basis for information provided in computer-generated monthly and weekly printed reports.
 - (b) Contractor shall explain all variances and mitigation measures.
- (9) Contractor may include any other information pertinent to status of Project. Contractor shall include additional status information requested by District at no additional cost.
- (10) Status reports, and the information contained therein, shall not be construed as claims, notice of claims, notice of delay, or requests for changes or compensation.

1.16 WEEKLY SCHEDULE REPORT

At the Weekly Progress Meeting, the Contractor shall provide and present a time-scaled three (3) week look-ahead schedule that is based and correlated by activity number to the current schedule (i.e., Initial, Original CPM, or Schedule Update).

1.17 DAILY CONSTRUCTION REPORTS

On a daily basis, Contractor shall submit a daily activity report to District for each workday, including weekends and holidays when worked. Contractor shall develop the daily construction reports on a computer-generated database capable of sorting daily Work, manpower, and man-hours by Contractor, Subcontractor, area, sub-area, and Change Order Work. Upon request of District, furnish computer disk of this data base. Obtain District's written approval of daily construction report data base format prior to implementation. Include in report:

- A. Project name and Project number.
- B. Contractor's name and address.
- C. Weather, temperature, and any unusual site conditions.
- D. Brief description and location of the day's scheduled activities and any special problems and accidents, including Work of Subcontractors. Descriptions shall be referenced to CPM scheduled activities.
- E. Worker quantities for its own Work force and for Subcontractors of any tier.
- F. Equipment, other than hand tools, utilized by Contractor and Subcontractors.

1.18 PERIODIC VERIFIED REPORTS

Contractor shall complete and verify construction reports on a form prescribed by the Division of the State Architect and file reports on the first day of February, May, August, and November during the preceding quarter year; at the completion of the Contract; at the completion of the Work; at the suspension of Work for a period of more than one (1) month; whenever the services of Contractor or any of Contractor's Subcontractors are terminated for any reason; and at any time a special verified report is required by the Division of the State Architect. Refer to section 4-336 and section 4-343 of Part 1, Title 24 of the California Code of Regulations.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 33 00

SUBMITTALS**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Contractor's Submittals and Schedules, Drawings and Specifications;
- B. Special Conditions.

1.02 SECTION INCLUDES:

- A. Definitions:
 - (1) Shop Drawings and Product Data are as indicated in the General Conditions and include, but are not limited to, fabrication, erection, layout and setting drawings, formwork and falsework drawings, manufacturers' standard drawings, descriptive literature, catalogues, brochures, performance and test data, wiring and control diagrams. In addition, there are other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems and all positions conform to the requirement of the Contract Documents, including, without limitation, the Drawings.
 - (2) "Manufactured" applies to standard units usually mass-produced; "fabricated" means specifically assembled or made out of selected materials to meet design requirements. Shop Drawings shall establish the actual detail of manufactured or fabricated items, indicated proper relation to adjoining work and amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure.
 - (3) Manufacturer's Instructions: Where any item of Work is required by the Contract Documents to be furnished, installed, or performed, at a minimum, in accordance with a specified product manufacturer's instructions, the Contractor shall procure and distribute copies of these to the District, the Architect, and all other concerned parties and shall furnish, install, or perform the work, at a minimum, in accordance with those instructions.
- B. Samples, Shop Drawings, Product Data, and other items as specified, in accordance with the following requirements:

- (1) Contractor shall submit all Shop Drawings, Product Data, and Samples to the District, the Architect, the Project Inspector, and the Construction Manager.
- (2) Contractor shall comply with all time frames herein and in the General Conditions and, in any case, shall submit required information in sufficient time to permit proper consideration and action before ordering any materials or items represented by such Shop Drawings, Product Data, and/or Samples.
- (3) Contractor shall allow sufficient time so that no delay occurs due to required lead time in ordering or delivery of any item to the Site. Contractor shall be responsible for any delay in progress of Work due to its failure to observe these requirements.
- (4) Time for completion of Work shall not be extended on account of Contractor's failure to promptly submit Shop Drawings, Product Data, and/or Samples.
- (5) Reference numbers on Shop Drawings shall have Architectural and/or Engineering Contract Drawings reference numbers for details, sections, and "cuts" shown on Shop Drawings. These reference numbers shall be in addition to any numbering system that Contractor chooses to use or has adopted as standard.
- (6) When the magnitude or complexity of submittal material prevents a complete review within the stated time frame, Contractor shall make this submittal in increments to avoid extended delays.
- (7) Contractor shall certify on submittals for review that submittals conform to Contract requirements. Also certify that Contractor-furnished equipment can be installed in allocated space. In event of any variance, Contractor shall specifically state in transmittal and on Shop Drawings, portions vary and require approval of a substitute. Submittals shall not be used as a means of requesting a substitution.
- (8) Unless specified otherwise, sampling, preparation of samples, and tests shall be in accordance with the latest standard of the American Society for Testing and Materials.
- (9) Upon demand by Architect or District, Contractor shall submit samples of materials and/or articles for tests or examinations and consideration before Contractor incorporates same in Work. Contractor shall be solely responsible for delays due to sample(s) not being submitted in time to allow for tests. Acceptance or rejection will be expressed in writing. Work shall be equal to approved samples in every respect. Samples that are of value after testing will remain the property of Contractor.

C. Submittal Schedule:

- (1) Contractor shall prepare its proposed submittal schedule that is coordinated with the its proposed construction schedule and submit both to the District within ten (10) days after the date of the Notice to Proceed. Contractor's proposed schedules shall become the Project Construction Schedule and the Project Submittal Schedule after each is approved by the District.
- (2) Contractor is responsible for all lost time should the initial submittal be rejected, marked "revise and resubmit", etc.
- (3) All Submittals shall be forwarded to the District by the date indicated on the approved Submittal Schedule, unless an earlier date is necessary to maintain the Construction Schedule, in which case those Submittals shall be forwarded to the District so as not to delay the Construction Schedule.
- (4) Contractor may be assessed \$100 a day for each day it is late in submitting a shop drawing or sample. No extensions of time will be granted to Trade Contractor or any Subcontractor because of its failure to have shop drawings and samples submitted in accordance with the Schedule.

1.03 SHOP DRAWINGS:

- A. Contractor shall submit Shop Drawings electronically, except for samples.
- B. Before commencing installation of any Work, the Contractor shall submit and receive approval of all drawings, descriptive data, and material list(s) as required to accomplish Work.
- C. Review of Shop Drawings is regarded as a service to assist Contractor and in all cases original Contract Documents shall take precedence as outlined under General Conditions.
- D. No claim for extra time or payment shall be based on work shown on Shop Drawings unless the claim is (1) noted on Contractor's transmittal letter accompanying Shop Drawings and (2) Contractor has complied with all applicable provisions of the General Conditions, including, without limitation, provisions regarding changes and payment, and all required written approvals.
- E. District shall not review Shop Drawings for quantities of materials or number of items supplied.
- F. District's and/or Architect's review of Shop Drawing will be general. District and/or Architect review does not relieve Contractor of responsibility for dimensions, accuracy, proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. The District's and/or Architect's review of Shop Drawings is not to be construed as approving departures from Contract Documents.

- G. Review of Shop Drawings and Schedules does not relieve Contractor from responsibility for any aspect of those Drawings or Schedules that is a violation of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction.
- H. Before submitting Shop Drawings for review, Contractor shall check Shop Drawings of its subcontractors for accuracy, and confirm that all Work contiguous with and having bearing on other work shown on Shop Drawings is accurately drawn and in conformance with Contract Documents.
- I. Submitted drawings and details must bear stamp of approval of Contractor:
 - (1) Stamp and signature shall clearly certify that Contractor has checked Shop Drawings for compliance with Drawings.
 - (2) If Contractor submits a Shop Drawing without an executed stamp of approval, or whenever it is evident (despite stamp) that Drawings have not been checked, the District and/or Architect will not consider them and will return them to the Contractor for revision and resubmission. In that event, it will be deemed that Contractor has not complied with this provision and Contractor shall bear risk of all delays to same extent as if it had not submitted any Shop Drawings or details.
- J. Submission of Shop Drawings (in either original submission or when resubmitted with correction) constitutes evidence that Contractor has checked all information thereon and that it accepts and is willing to perform Work as shown.
- K. Contractor shall pay for cost of any changes in construction due to improper checking and coordination. Contractor shall be responsible for all additional costs, including coordination. Contractor shall be responsible for costs incurred by itself, the District, the Architect, the Project Inspector, the Construction Manager, any other Subcontractor or contractor, etc., due to improperly checked and/or coordination of submittals.
- L. Shop Drawings must clearly delineate the following information:
 - (1) Project name and address.
 - (2) Specification number and description.
 - (3) Architect's name and project number.
 - (4) Shop Drawing title, number, date, and scale.
 - (5) Names of Contractor, Subcontractor(s) and fabricator.
 - (6) Working and erection dimensions.
 - (7) Arrangements and sectional views.

- (8) Necessary details, including complete information for making connections with other Work.
 - (9) Kinds of materials and finishes.
 - (10) Descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Contractor shall use same reference identification(s) as shown on Contract Drawings.
- M. Contractor shall prepare composite drawings and installation layouts when required to solve tight field conditions.
- (1) Shop Drawings shall consist of dimensioned plans and elevations and must give complete information, particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc.
 - (2) Contractor shall coordinate these composite Shop Drawings and installation layouts in the field between itself and its Subcontractor(s) for proper relationship to the Work, the work of other trades, and the field conditions. The Contractor shall check and approve all submittal(s) before submitting them for final review.

1.04 PRODUCT DATA OR NON REPRODUCIBLE SUBMITTALS:

- A. Contractor shall submit manufacturer's printed literature electronically.
- B. Contractor shall submit a complete list of all major items of mechanical, plumbing, and electrical equipment and materials in accordance with the approved Submittal Schedule, except as required earlier to comply with the approved Construction Schedule. Other items specified are to be submitted prior to commencing Work. Contractor shall submit items of like kind at one time in a neat and orderly manner. Partial lists will not be acceptable.
- C. Submittals shall include manufacturer's specifications, physical dimensions, and ratings of all equipment. Contractor shall furnish performance curves for all pumps and fans. Where printed literature describes items in addition to that item being submitted, submitted item shall be clearly marked on sheet and superfluous information shall be crossed out. If highlighting is used, Contractor shall mark all copies.
- D. Equipment submittals shall be complete and include space requirements, weight, electrical and mechanical requirements, performance data, and supplemental information that may be requested.
- E. Imported Materials Certification must be submitted at least ten (10) days before material is delivered.

1.05 SAMPLES:

- A. Contractor shall submit for approval Samples as required and within the time frame in the Contract Documents. Materials such as concrete, mortar, etc., which require on-site testing will be obtained from Project Site.
- B. Contractor shall submit four (4) samples except where greater or lesser number is specifically required by Contract Documents including, without limitation, the Specifications.
 - (1) Samples must be of sufficient size and quality to clearly illustrate functional characteristics, with integrally related parts and attachment devices.
 - (2) Samples must show full range of texture, color, and pattern.
- C. Contractor shall make all Submittals, unless it has authorized Subcontractor(s) to submit and Contractor has notified the District in writing to this effect.
- D. Samples to be shipped prepaid or hand-delivered to the District.
- E. Contractor shall mark samples to show name of Project, name of Contractor submitting, Contract number and segment of Work where representative Sample will be used, all applicable Specifications Sections and documents, Contract Drawing Number and detail, and ASTM or FS reference, if applicable.
- F. Contractor shall not deliver any material to Site prior to receipt of District's and/or Architect's completed written review and approval. Contractor shall furnish materials equal in every respect to approved Samples and execute Work in conformance therewith.
- G. District's and/or Architect's review, acceptance, and/or approval of Sample(s) will not preclude rejections of any material upon discovery of defects in same prior to final acceptance of completed Work.
- H. After a material has been approved, no change in brand or make will be permitted.
- I. Contractor shall prepare its Submittal Schedule and submit Samples of materials requiring laboratory tests to specified laboratory for testing not less than ninety (90) days before such materials are required to be used in Work.
- J. Samples which are rejected must be resubmitted promptly after notification of rejection and be marked "Resubmitted Sample" in addition to other information required.
- K. Field Samples and Mock-Ups are to be removed by Contractor at District's direction:
 - (1) Size: As Specified.

- (2) Furnish catalog numbers and similar data, as requested.

1.06 REVIEW AND RESUBMISSION REQUIREMENTS:

- A. The District will arrange for review of Sample(s), Shop Drawing(s), Product Data, and other submittal(s) by appropriate reviewer and return to Contractor as provided below within twenty-one (21) days after receipt or within twenty-one (21) days after receipt of all related information necessary for such review, whichever is later.
- B. One (1) copy of product or materials data will be returned to Contractor with the review status.
- C. Samples to be incorporated into the Work will be returned to Contractor, together with a written notice designating the Sample with the appropriate review status and indicating errors discovered on review, if any. Other Samples will not be returned, but the same notice will be given with respect thereto, and that notice shall be considered a return of the Sample.
- D. Contractor shall revise and resubmit any Sample(s), Shop Drawing(s), Product Data, and other submittal(s) as required by the reviewer. Such resubmittals will be reviewed and returned in the same manner as original Sample(s), Shop Drawing(s), Product Data, and other submittal(s), within fourteen (14) days after receipt thereof or within fourteen (14) days after receipt of all related information necessary for such review. Such resubmittal shall not delay the Work.
- E. Contractor may proceed with any of the Work covered by Sample(s), Shop Drawing(s), Product Data, and other submittal(s) upon its return if designated as no exception taken, or revise as noted, provided the Contractor proceeds in accordance with the District and/or the Architect's notes and comments.
- F. Contractor shall not begin any of the work covered by a Sample(s), Shop Drawing(s), Product Data, and other submittal(s), designated as revise and resubmit or rejected, until a revision or correction thereof has been reviewed and returned to Contractor.
- G. Sample(s), Shop Drawing(s), Product Data, and other submittal(s) designated as revise and resubmit or rejected and requiring resubmittal, shall be revised or corrected and resubmitted to the District no later than fourteen (14) days or a shorter period as required to comply with the approved Construction Schedule, after its return to Contractor.
- H. Neither the review nor the lack of review of any Sample(s), Shop Drawing(s), Product Data, and other submittal(s) shall waive any of the requirements of the Contract Documents, or relieve Contractor of any obligation thereunder.
- I. District's and/or Architect's review of Shop Drawings does not relieve the Contractor of responsibility for any errors that may exist. Contractor is responsible for the dimensions and design of adequate connections and details and for satisfactory construction of all the Work.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 35 13.23

SITE STANDARDS**PART 1 – GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including without limitation, Site Access, Conditions, and Regulations;
- B. Special Conditions;
- C. Drug-Free Workplace Certification;
- D. Tobacco-Free Environment Certification;
- E. Criminal Background Investigation/Fingerprinting Certification;
- F. Temporary Facilities and Controls.

1.02 REQUIREMENTS OF THE DISTRICT:

- A. Drug-Free Schools and Safety Requirements:
 - (1) All school sites and other District Facilities have been declared "Drug-Free Zones." No drugs, alcohol and/or smoking are allowed at any time in any buildings and/or grounds on District property. No students, staff, visitors, or contractors are to use drugs on these sites.
 - (2) Smoking and the use of tobacco products by all persons is prohibited on or in District property. District property includes school buildings, school grounds, school-owned vehicles and vehicles owned by others while on District property. Contractor shall post: "Non-Smoking Area" in a highly visible location in each work area, staging area, and parking area. Contractor may designate a smoking area outside of District property within the public right-of-way, provided that this area remains quiet and unobtrusive to adjacent neighbors. This smoking area is to be kept clean at all times.
 - (3) Contractor shall ensure that no alcohol, firearms, weapons, or controlled substances enter or are used at the Site. Contractor shall immediately remove from the Site and terminate the employment of any employee(s) found in violation of this provision.
- B. Language: Profanity or other unacceptable and/or loud language will not be tolerated, "Cat calls" or other derogatory language toward students, staff, volunteers, parents or public will not be allowed.

- C. Disturbing the Peace (Noise and Lighting):
- (1) Contractor shall observe the noise ordinance of the Site at all times including, without limitation, all applicable local, city, and/or state laws, ordinances, and/or regulations regarding noise and allowable noise levels.
 - (2) The use of radios, etc., shall be controlled to keep all sound at a level that cannot be heard beyond the immediate area of use. District reserves the right to prohibit the use of radios at the Site, except for mobile phones or other handheld communication radios.
 - (3) If portable lights are used after dark, all light must be located so as not to direct light into neighboring property.
- D. Traffic:
- (1) Driving on the Premises shall be limited to periods when students and public are not present. If driving or deliveries must be made during the school hours, two (2) or more ground guides shall lead the vehicle across the area of travel. In no case shall driving take place across playgrounds or other pedestrian paths during recess, lunch, and/or class period changes. The speed limit on-the Premises shall be five (5) miles per hour (maximum) or less if conditions require.
 - (2) All paths of travel for deliveries, including without limitation, material, equipment, and supply deliveries, shall be reviewed and approved by District in advance. Any damage will be repaired to the pre-damaged condition by the Contractor.
 - (3) District shall designate a construction entry to the Site. If Contractor requests, District determines it is required, and to the extent possible, District shall designate a staging area so as not to interfere with the normal functioning of school facilities. Location of gates and fencing shall be approved in advance with District and at Contractor's expense.
 - (4) Parking areas shall be reviewed and approved by District in advance. No parking is to occur under the drip line of trees or in softscape areas that could otherwise be damaged.
- E. All of the above shall be observed and complied with by the Contractor and all workers on the Site. Failure to follow these directives could result in individual(s) being suspended or removed from the work force at the discretion of the District. The same rules and regulations shall apply equally to delivery personnel, inspectors, consultants, and other visitors to the Site.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

PART 4 - SITE LOGISTICS PLANS

See next two pages.

END OF DOCUMENT

DOCUMENT 01 41 00

REGULATORY REQUIREMENTS**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Obtaining of Permits, Licenses and Registrations and Work to Comply with All Applicable Laws and Regulations;
- B. Special Conditions; and
- C. Quality Control.

1.02 DESCRIPTION:

This section covers the general requirements for regulatory requirements pertaining to the Work and is supplementary to all other regulatory requirements mentioned or referenced elsewhere in the Contract Documents.

1.03 REQUIREMENTS OF REGULATORY AGENCIES:

- A. All statutes, ordinances, laws, rules, codes, regulations, standards, and the lawful orders of all public authorities having jurisdiction over the Work, are hereby incorporated into these Contract Documents as if repeated in full herein and are intended to be included in any reference to Code or Building Code, unless otherwise specified, including, without limitation, the references in the list below. Contractor shall make available at the Site copies of all the listed documents applicable to the Work as the District and/or Architect may request, including, without limitation, applicable portions of the California Code of Regulations ("CCR").
 - (1) California Building Standards Administrative Code, Part 1, Title 24, CCR.
 - (2) California Building Code (CBC), Part 2, Title 24, CCR; (International Building Code volumes 1-2 and California Amendments).
 - (3) California Electrical Code (CEC), Part 3, Title 24, CCR; (National Electrical Code and California Amendments).
 - (4) California Mechanical Code (CMC), Part 4, Title 24, CCR; (Uniform Mechanical Code and California Amendments).
 - (5) California Plumbing Code (CPC), Part 5, Title 24, CCR; (Uniform Plumbing Code and California Amendments).

- (6) California Fire Code (CFC), Part 9, Title 24, CCR; (International Fire Code and California Amendments).
- (7) California Green Building Standards Code (CALGreen), Part 11, Title 24, CCR.
- (8) California Referenced Standards Code, Part 12, Title 24, CCR.
- (9) State Fire Marshal Regulations, Public Safety, Title 19, CCR.
- (10) Partial List of Applicable National Fire Protection Association (NFPA) Standards:
 - (a) NFPA 13 - Automatic Sprinkler System.
 - (b) NFPA 14 - Standpipes Systems.
 - (c) NFPA 17A - Wet Chemical System
 - (d) NFPA 24 - Private Fire Mains.
 - (e) (California Amended) NFPA 72 - National Fire Alarm Codes.
 - (f) NFPA 253 - Critical Radiant Flux of Floor Covering System.
 - (g) NFPA 2001 - Clean Agent Fire Extinguishing Systems.
- (11) California Division of the State Architect interpretation of Regulations ("DSA IR"), including, without limitation:
 - (a) DSA IR A-6 — Construction Change Document Submittal and Approval Processes.
 - (b) DSA IR A-7 — Project Inspector Certification and Approval.
 - (c) DSA IR A-8 — Project Inspector and Assistant Inspector Duties and Performance.
 - (d) DSA IR A-12 — Assistant Inspector Approval.
- (12) DSA Procedures ("DSA PR")
 - (a) DSA PR 13-01 – Construction Oversight Process
- (13) DSA PR 13-02 – Project Certification Process

B. This Project shall be governed by applicable regulations, including, without limitation, the State of California's Administrative Regulations for the Division of the State Architect-Structural Safety (DSA/SS), Chapter 4, Part 1, Title 24, CCR, and the most current version on the date the bids are opened and as it pertains to school construction including, without limitation:

- (1) Test and testing laboratory per Section 4-335. District shall pay for the testing laboratory.
- (2) Special inspections per Section 4-333(c).
- (3) Deferred Approvals per section 4-317(g).
- (4) Verified reports per Sections 4-336 & 4-343(c).
- (5) Duties of the Architect & Engineers shall be per Section 4-333(a) and 4-341.
- (6) Duties of the Contractor shall be per Section 4-343.
- (7) Duties of Project Inspector shall be per Section 4-334.
- (8) Addenda and Construction Change Documents per Section 4-338.

Contractor shall keep and make available all applicable parts of the most current version of Title 24 referred to in the plans and specifications at the Site during construction.

C. Items of deferred approval shall be clearly marked on the Architect's and/or Engineer's approved Drawings. All items later submitted for approval shall be per Title 24 requirements to the DSA.

- (1) Contractor shall submit the following to Architect for review and endorsement:
 - (a) Product information on proposed material/system supplier.
 - (b) Drawings, specifications, and calculations prepared, signed, and stamped by an architect or engineer licensed in the State of California for that portion of the Work.
 - (c) All other requirements as may be required by DSA.
- (2) Cost of preparing and submitting documentation per DSA Deferred Approval requirements including required modifications to Drawings and Specifications, whether or not indicated in the Contract Documents, shall be borne by Contractor.
- (3) Contractor shall not begin fabrication and installation of deferred approval items without first obtaining DSA approval of Drawings and Specifications.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

ABBREVIATIONS AND ACRONYMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions including without limitation, Definitions;
- B. Special Conditions.

1.02 DOCUMENT INCLUDES:

- A. Abbreviations used throughout the Contract Documents.
- B. Reference to a technical society, organization, or body is by abbreviation, as follows:

1.	AA	Aluminum Association
2.	AAMA	Architectural Aluminum Manufacturers Association
3.	AASHTO	American Association of State Highway and Transportation Officials
4.	ABPA	Acoustical and Board Products Association
5.	ACI	American Concrete Institute
6.	AGA	American Gas Association
7.	AGC	Associated General Contractors
8.	AHC	Architectural Hardware Consultant
9.	AHRI	Air Conditioning, Heating, Refrigeration Institute
10.	AI	Asphalt Institute
11.	AIA	American Institute of Architects
12.	AIEE	American Institute of Electrical Engineers
13.	AISC	American Institute of Steel Construction
14.	AISI	American Iron and Steel Institute
15.	AMCA	Air Moving and Conditioning Association
16.	ANSI	American National Standards Institute
17.	APA	American Plywood Association
18.	ARI	Air Conditioning and Refrigeration Institute
19.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
20.	ASSE	American Society of Civil Engineers
21.	ASME	American Society of Mechanical Engineers
22.	ASTM	American Society of Testing and Materials
23.	AWPA	American Wood Protection Association
24.	AWPI	American Wood preservers Institute
25.	AWS	American Welding Society
26.	AWSC	American Welding Society Code

27.	AWI	Architectural Woodwork Institute
28.	AWWA	American Water Works Association
29.	BIA	The Brick Industry Association
30.	CCR	California Code of Regulations
31.	CLFMI	Chain Link Fence Manufacturers Institute
32.	CRA	California Redwood Association
33.	CRSI	Concrete Reinforcing Steel Institute
34.	CS	Commercial Standards
35.	CSI	Construction Specifications Institute
36.	CTI	Cooling Tower Institute
37.	FGMA	Flat Glass Manufacturer's Association
38.	FIA	Factory Insurance Association
39.	FM	Factory Mutual Global
40.	FS/FED SPEC	Federal Specification
41.	FTI	Facing Title Institute
42.	GA	Gypsum Association
43.	IAPMO	International Association of Plumbing and Mechanical Officials
44.	ICC	International Code Council
45.	IEEE	Institute of Electrical and Electronic Engineers
46.	IES	Illumination Engineering Society
47.	LIA	Lead Industries Association
48.	MCAC	Mason Contractors Association of California
49.	MIMA	Mineral Wool Insulation Manufacturers Association
50.	MLMA	Metal Lath Manufacturers Association
51.	MS/MIL SPEC	Military Specifications
52.	NAAMM	National Association of Architectural Metal Manufacturers
53.	NBHA	National Builders Hardware Association
54.	NBFU	National Board of Fire Underwriters
55.	NBS	National Bureau of Standards
56.	NCMA	National Concrete Masonry Association
57.	NCSEA	National Council of Structural Engineers Associations
58.	NEC	National Electrical Code
59.	NEMA	National Electrical Manufacturers Association
60.	NSI	Natural Stone Institute
61.	NTMA	National Terrazzo and Mosaic Association
62.	NWMA	National Woodwork Manufacturer's Association
63.	ORS	Office of Regulatory Services (California)
64.	OSHA	Occupational Safety and Health Act
65.	PCI	Precast Concrete Institute
66.	PCA	Portland Cement Association
67.	PDCA	Painting and Decorating Contractors of America
68.	PDI	Plumbing Drainage Institute
69.	PEI	Porcelain Enamel Institute
70.	PG&E	Pacific Gas & Electric Company
71.	PS	Product Standards
72.	SDI	Steel Door Institute; Steel Deck Institute

73.	SJI	Steel Joist Institute
74.	SSPC	Steel Structures Painting Council
75.	TPI	Truss Plate Institute
76.	UL	Underwriters Laboratories Code
77.	UMC	Uniform Mechanical Code
78.	USDA	United States Department of Agriculture
79.	VI	Vermiculite Institute
80.	WCLIB	West Coast Lumberman's Inspection Bureau
81.	WEUSER	Western Electric Utilities Service Engineering Requirements
82.	WIC	Woodwork Institute of California

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 42 16

DEFINITIONS**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions including without limitation, Definitions;
- B. Special Conditions.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, or Federal Standards, Contractor shall comply with requirements of the standard, except when more rigid requirements are specified in the Contract Documents, or are required by applicable codes.
- B. Contractor shall conform to current reference standard publication date in effect on the date of bid opening.
- C. Contractor shall obtain copies of standards unless specifically required not to by the Contract Documents.
- D. Contractor shall maintain a copy of all standards at jobsite during submittals, planning, and progress of the specific Work, until final completion, unless specifically required not to by the Contract Documents.
- E. Should specified reference standards conflict with Contract Documents, Contractor shall request clarification from the District and./or the Architect before proceeding.
- F. The contractual relationship of the parties to the Contract shall not be altered from the contractual relationship as indicated in the Contract Documents by mention or inference otherwise in any referenced document.
- G. Governing Codes shall be as shown in the Contract Documents including, without limitation, the Specifications.

END OF DOCUMENT

**SECTION 01 4219
REFERENCE STANDARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with the reference standard of date of issue specified in this section, except where a specific date is established by applicable code.
- C. Obtain copies of standards when required by Contract Documents.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Date of Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 3GPP -- 3RD GENERATION PARTNERSHIP PROJECT

- A. 3GPP Specification - The 3GPP Specifications (IoT or Mobile Broadband Standard): 5G, GSM (GPRS, EDGE, EDGE+), W-CDMA (HSPA, HSPA+), LTE (LTE-Advanced, LTE-Advanced Pro), and UMTS; Current Edition.

2.02 AA -- ALUMINUM ASSOCIATION, INC.

2.03 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

- A. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
- B. AAMA 501.4 - Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts; 2018.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- F. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2017a.
- G. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

- H. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- I. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- J. AAMA CW-DG-1 - Aluminum Curtain Wall Design Guide Manual; 1996, with Editorial Revision (2005).

2.04 ACI -- AMERICAN CONCRETE INSTITUTE INTERNATIONAL

- A. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.

2.05 AISC -- AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

- A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- C. AISC 360 - Specification for Structural Steel Buildings; 2016.

2.06 AMCA -- AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

- A. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.

2.07 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- B. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.
- C. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- F. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- G. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- H. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Reaffirmed 2016).
- I. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- J. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- K. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.
- L. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2012.
- M. ANSI A208.1 - American National Standard for Particleboard; 2009.

- N. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- O. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- P. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- Q. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
- R. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- S. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- T. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.
- U. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
- V. ANSI/ASSP Z359.16 - Safety Requirements for Climbing Ladder Fall Arrest Systems; 2016.

2.08 ASCE -- AMERICAN SOCIETY OF CIVIL ENGINEERS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

2.09 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

- A. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

2.10 ASME -- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

- A. ASME A17.1 - Safety Code for Elevators and Escalators; 2016.
- B. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks; 2014.
- C. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011.
- D. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors; 2013.

2.11 ASTM A SERIES -- ASTM INTERNATIONAL

- A. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2017.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2018.
- E. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- H. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- I. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
- J. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- K. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- L. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- M. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.
- N. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
- O. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- P. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- Q. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- R. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015.
- S. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- T. ASTM A820/A820M - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete; 2016.
- U. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2012 (Reapproved 2017).
- V. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- W. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

2.12 ASTM B SERIES -- ASTM INTERNATIONAL

- A. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- F. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2010.
- G. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017.
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.

2.13 ASTM C SERIES -- ASTM INTERNATIONAL

- A. ASTM C78/C78M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading); 2018.
- B. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- D. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- E. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- F. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2017a.
- G. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- I. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
- J. ASTM C206 - Standard Specification for Finishing Hydrated Lime; 2014.
- K. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- L. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- M. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- N. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.
- O. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2017.
- P. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- Q. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- R. ASTM C476 - Standard Specification for Grout for Masonry; 2019.
- S. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- T. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

- U. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- V. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- W. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- X. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
- Y. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- Z. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- AA. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2019.
- AB. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- AC. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- AD. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2018b.
- AE. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2003 (Reapproved 2018).
- AF. ASTM C847 - Standard Specification for Metal Lath; 2018.
- AG. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- AH. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters; 2015.
- AI. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- AJ. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2018a.
- AK. ASTM C933 - Standard Specification for Welded Wire Lath; 2018.
- AL. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- AM. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- AN. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.
- AO. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2019.
- AP. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- AQ. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- AR. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

- AS. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2019.
- AT. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2019.
- AU. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- AV. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.
- AW. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2014).
- AX. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- AY. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- AZ. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- BA. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- BB. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2018a.
- BC. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- BD. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2018.
- BE. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.
- BF. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2017a.
- BG. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- BH. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength ; 2009.
- BI. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- BJ. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
- BK. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.
- BL. ASTM C1787 - Standard Specification for Installation of Non Metallic Plaster Bases (Lath) Used with Portland Cement Based Plaster in Vertical Wall Applications; 2014.
- BM. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2015.

2.14 ASTM D SERIES -- ASTM INTERNATIONAL

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- B. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017.
- C. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010 (Reapproved 2018).

- D. ASTM D905 - Standard Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading; 2008 (Reapproved 2013).
- E. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- F. ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films; 2013.
- G. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
- H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- I. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
- J. ASTM D4259 - Standard Practice for Abrading Concrete; 1988 (Reapproved 2012).
- K. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.
- L. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
- M. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007, with Editorial Revision (2012).
- N. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes, and Related Products; 2007, with Editorial Revision (2013).
- O. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2017.

2.15 ASTM E SERIES -- ASTM INTERNATIONAL

- A. ASTM E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction; 2015.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2018c.
- F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016a.
- G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- H. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- K. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- L. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2018.
- M. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014a.
- N. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2015.
- O. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference; 2000 (Reapproved 2016).
- P. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.
- Q. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2017.
- R. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
- S. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.
- T. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- U. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013, with Editorial Revision.
- V. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- W. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
- X. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.
- Y. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- Z. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- AA. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011 (Reapproved 2017).
- AB. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
- AC. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015.
- AD. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007 (Reapproved 2016).

- AE. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2018.
- AF. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- AG. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015b, with Editorial Revision (2016).
- AH. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a (Reapproved 2015).
- AI. ASTM E2573 - Standard Practice for Specimen Preparation and Mounting of Site-Fabricated Stretch Systems to Assess Surface Burning Characteristics; 2019.
- AJ. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).

2.16 ASTM F SERIES -- ASTM INTERNATIONAL

- A. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.
- B. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
- C. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2017.
- D. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2015).
- E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.
- F. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2015.
- G. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2018.
- H. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- J. ASTM F1941 - Standard Specification for Electrodeposited Coatings on Threaded Fasteners; 2010.
- K. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- L. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.
- M. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).
- N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.

2.17 ASTM G SERIES -- ASTM INTERNATIONAL

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

- 2.18 AWI/AWMAC/WI -- JOINT PUBLICATION OF ARCHITECTURAL WOODWORK INSTITUTE/ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA/WOODWORK INSTITUTE**
- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- 2.19 AWMAC/WI -- JOINT PUBLICATION OF ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA/WOODWORK INSTITUTE**
- A. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- 2.20 AWS -- AMERICAN WELDING SOCIETY**
- A. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
 - B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- 2.21 BHMA -- BUILDERS HARDWARE MANUFACTURERS ASSOCIATION**
- A. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
 - B. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- 2.22 CARB -- CALIFORNIA AIR RESOURCES BOARD**
- A. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
 - B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- 2.23 CRI -- CARPET AND RUG INSTITUTE**
- A. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- 2.24 FM -- FACTORY MUTUAL GLOBAL**
- A. FM (AG) - FM Approval Guide; current edition.
 - B. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- 2.25 GA -- GYPSUM ASSOCIATION**
- A. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
 - B. GA-600 - Fire Resistance Design Manual; 2015.
- 2.26 GANA -- GLASS ASSOCIATION OF NORTH AMERICA**
- A. GANA (GM) - GANA Glazing Manual; 2008.
 - B. GANA (SM) - GANA Sealant Manual; 2008.
- 2.27 IAS -- INTERNATIONAL ACCREDITATION SERVICE**
- A. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.
- 2.28 ICC -- INTERNATIONAL CODE COUNCIL, INC.**
- A. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
 - B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- C. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

2.29 ICRI -- INTERNATIONAL CONCRETE REPAIR INSTITUTE

- A. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

2.30 ISFA - INTERNATIONAL SURFACE FABRICATORS ASSOCIATION

- A. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

2.31 ITS -- INTERTEK TESTING SERVICES NA, INC.

- A. ITS (DIR) - Directory of Listed Products; current edition.

2.32 MPI -- MASTER PAINTERS INSTITUTE (MASTER PAINTERS AND DECORATORS ASSOCIATION)

- A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

2.33 NAAMM -- THE NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS

- A. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- B. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- C. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- D. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- E. NAAMM AMP 510 - Metal Stairs Manual; 1992.

2.34 NEMA -- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- B. NEMA MG 1 - Motors and Generators; 2017.

2.35 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2017.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.
- D. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- F. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.
- G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.
- H. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

2.36 NFRC -- NATIONAL FENESTRATION RATING COUNCIL, INC.

- A. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.

- B. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
- C. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

2.37 NRCA -- NATIONAL ROOFING CONTRACTORS ASSOCIATION

- A. NRCA (RM) - The NRCA Roofing Manual; 2018.

2.38 NTMA -- NATIONAL TERRAZZO AND MOSAIC ASSOCIATION, INC., THE

- A. NTMA (GRAD) - Aggregate Gradation Standards; Current Edition.
- B. NTMA (EPOXY) - Epoxy Terrazzo Specifications; Current Edition.

2.39 RFCI -- RESILIENT FLOOR COVERING INSTITUTE

- A. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

2.40 SCAQMD -- SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

- A. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- B. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

2.41 SMACNA -- SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.

- A. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

2.42 SPRI -- SINGLE PLY ROOFING INDUSTRY

- A. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

2.43 SSPC -- SOCIETY FOR PROTECTIVE COATINGS

- A. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; 2016.
- B. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; 2015.
- C. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- D. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel; 2016.
- E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- F. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).
- G. SSPC-SP 3 - Power Tool Cleaning; 1982, with Editorial Revision (2004).
- H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- I. SSPC-SP 7 - Brush-Off Blast Cleaning; 2007.
- J. SSPC-SP 11 - Power Tool Cleaning to Bare Metal; 2012 (Ed. 2013).
- K. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

2.44 SWRI -- SEALANT, WATERPROOFING AND RESTORATION INSTITUTE

- A. SWRI (VAL) - SWRI Institute Validated Products Directory; Current Edition.

2.45 TCNA -- TILE COUNCIL OF NORTH AMERICA, INC.

- A. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2017.

2.46 TMS -- THE MASONRY SOCIETY

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

2.47 UL -- UNDERWRITERS LABORATORIES INC.

- A. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- B. UL (DIR) - Online Certifications Directory; Current Edition.
- C. UL (FRD) - Fire Resistance Directory; Current Edition.
- D. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- E. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

2.48 WCMA -- WINDOW COVERING MANUFACTURERS ASSOCIATION

- A. WCMA A100.1 - Safety of Window Covering Products; 2018.

2.49 WDMA -- WINDOW AND DOOR MANUFACTURERS ASSOCIATION (FORMERLY NWWDA)

- A. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

2.50 WI -- WOODWORK INSTITUTE

- A. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- B. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- C. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

PART 3 UNITED STATES GOVERNMENT AND RELATED AGENCIES DOCUMENTS

3.01 CFR -- CODE OF FEDERAL REGULATIONS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.
- C. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- D. 29 CFR 1910.28 - Duty to have Fall Protection and Falling Object Protection; Current Edition.
- E. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- F. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- G. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- H. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.

3.02 FHWA -- FEDERAL HIGHWAY ADMINISTRATION

- A. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

3.03 FS -- FEDERAL SPECIFICATIONS AND STANDARDS (GENERAL SERVICES ADMINISTRATION)

- A. GSA CID A-A-1936 - Adhesive, Contact, Neoprene Rubber; 1996a (Validated 2013).
- B. FS TT-P-1952 - Paint, Traffic Black, and Airfield Marking, Waterborne; 2015f.

END OF SECTION

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REFERENCES

PART 1 - GENERAL

1.01 1.01 SCHEDULE OF REFERENCES:

The following information is intended only for the general assistance of the Contractor, and the District does not represent that all of the information is current. It is the Contractor's responsibility to verify the correct information for each of the entities listed.

AA	Aluminum Association 1525 Wilson Blvd., Suite 600 Arlington, VA 22209 www.aluminum.org	703/358-2960
AABC	Associated Air Balance Council 1518 K Street, NW, Suite 503 Washington, DC 20005 www.aabchq.com	202/737-0202
AAMA	American Architectural Manufacturers Association 1827 Walden Office Sq., Suite 550 Schaumburg, IL 60173-4268 www.aamanet.org	847/303-5664
AASHTO	American Association of State Highway and Transportation Officials 444 N Capitol St. NW - Suite 249 Washington, DC 20001 www.transportation.org	202/624-5800
AATCC	American Association of Textile Chemists and Colorists P.O. Box 12215 One Davis Drive Research Triangle Park, NC 27709 2215 www.aatcc.org	919/549-8141

ACA	American Coatings Association 1500 Rhode Island Ave., NW Washington DC, 20005 www.paint.org	202/462-6272
ACI	American Concrete Institute 38800 Country Club Dr. Farmington Hills, MI 48331-3439 www.aci-int.org	248/848-3700
ACPA	American Concrete Pipe Association 8445 Freeport Parkway, Suite 350 Irving, TX 75063-2595 www.concrete-pipe.org	972/506-7216
ADC	Air Diffusion Council 1901 N. Roselle Road, Suite 800 Schaumburg, Illinois 60195 www.flexibleduct.org	847/706-6750
AF&PA	American Forest and Paper Association 1111 Nineteenth Street, NW, Suite 800 Washington, DC 20036 www.afandpa.org	202/463-2700
AGA	American Gas Association 400 North Capitol Street, NW Washington, DC 20001 www.aga.org	202/824-7000
AGC	Associate General Contractors of America 2300 Wilson Blvd., Suite 400 Arlington, VA 22201 www.agc.org	703/548-3118
AHA	American Hardboard Association 1210 West Northwest Highway Palatine, IL 60067 domensino.com/AHA/default.htm	847/934-8800
AI	Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480 www.asphaltinstitute.org	859/288-4960

AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006-5292 www.aia.org	202/626-7300
AISC	American Institute of Steel Construction One East Wacker Drive Suite 700 Chicago, IL 60601-1802 www.aisc.org	312.670.2400
AIA	American Insurance Association (formerly the National Board of Fire Underwriters) 2101 L Street, NW, Suite 400 Washington, DC 20037 www.aiadc.org	202/828-7100
AISI	American Iron and Steel Institute 25 Massachusetts Ave., NW, Suite 800 Washington, DC 20001 www.steel.org	202/452.7100
AITC	American Institute of Timber Construction 7012 S. Revere Parkway Suite 140 Centennial, CO 80112 www.aitc-glulam.org	303/792.9559
ALI	Associated Laboratories, Inc. P.O. Box 152837 Dallas, TX 75315 www.assoc-labs.com	214/565-0593
ALSC	American Lumber Standards Committee, Inc. P.O. Box 210 Germantown, MD 20875 www.alsc.org	301/972-1700
AMCA	Air Movement and Control Association International, Inc. 30 W. University Drive Arlington Heights, IL 60004 www.amca.org	847/394-0150
ANLA	American Nursery & Landscape Association 1200 G Street NW, Suite 800 Washington, DC 20005 www.anla.org	202/789-2900
ANSI	American National Standards Institute 1899 L Street, NW, 11th Floor Washington, DC, 20036 www.ansi.org	202/293.8020

APA	APA-The Engineered Wood Association 7011 S. 19th Street Tacoma, WA 98466-5333 www.apawood.org	253/565-6600
APA	Architectural Precast Association 6710 Winkler Road, Suite 8 Fort Myers, Florida 33919 www.archprecast.org	239/454-6989
ARI	Air Conditioning and Refrigeration Institute 4100 N. Fairfax Drive, Suite 200 Arlington, VA 22203 www.lightindustries.com/ARI	703/524-8800
ARMA	Asphalt Roofing Manufacturers Association Public Information Department 750 National Press Building 529 14th Street, NW Washington, DC 20045 www.asphaltroofing.org	202/591-2450
ASA	The Acoustical Society of America ASA Office Manager Suite 1NO1 2 Huntington Quadrangle Melville, NY 11747-4502 http://asa.aip.org	516/576-2360
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 www.asce.org	800/548-2723 703/295-6300
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329-2305 www.ashrae.org	800/527-4723 404/636-8400
ASLA	American Society of Landscape Architects 636 Eye Street, NW Washington, DC 20001-3736 www.asla.org	202/898-2444
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016-5990 www.asme.org	800/434-2763

ASPE	American Society of Plumbing Engineers 2980 S River Rd. Des Plaines, IL 60018 http://aspe.org	847/296-0002
ASQ	American Society for Quality P.O. Box 3005 Milwaukee, WI 53201-3005 or 600 North Plankinton Avenue Milwaukee, WI 53203 http://asq.org	800/248-1946 414/272-8575
ASSE	American Society of Sanitary Engineering 901 Canterbury, Suite A Westlake, Ohio 44145 www.asse-plumbing.org	440/835-3040
ASTM	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 www.astm.org	610/832-9500
AWCI	Association of the Wall and Ceiling Industry 513 West Broad Street, Suite 210 Falls Church, VA 22046 www.awci.org	703/538-1600
AWPA	American Wood Protection Association P.O. Box 361784 Birmingham, AL 35236-1784 www.awpa.com	205/733-4077
AWPI	American Wood Preservers Institute 2750 Prosperity Ave. Suite 550 Fairfax, VA 22031-4312 www.arcata.com	800/356-AWPI 703/204-0500
AWS	American Welding Society 8669 Doral Boulevard, Suite 130 Doral, Florida 33166 www.aws.org	800/443-9353 305/443-9353
AWI	Architectural Woodwork Institute 46179 Westlake Drive, Suite 120 Potomac Falls, VA 20165-5874 www.awinet.org	571/323-3636

AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org	800/926-7337 303/794 7711
BHMA	Builders Hardware Manufacturers Association 355 Lexington Avenue, 15th floor New York, NY 10017 www.buildershardware.com	212/297-2122
BIA	The Brick Industry Association 1850 Centennial Park Drive, Suite 301 Reston, VA 20191 www.gobrick.com	703/620-0010
CGA	Compressed Gas Association 14501 George Carter Way, Suite 103 Chantilly VA 20151-2923 www.cganet.com	703/788-2700
CISCA	Ceilings & Interior Systems Construction Association 1010 Jorie Blvd, Suite 30 Oak Brook, IL 60523 www.cisca.org	630/584-1919
CISPI	Cast Iron Soil Pipe Institute 1064 Delaware Avenue SE Atlanta, GA 30316 www.cispi.org	404/622-0073
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Road, Suite B-215 Columbia, MD 21046 www.associationsites.com/main-pub.cfm?usr=clfma	410/290-6267
CPA	Composite Panel Association 19465 Deerfield Avenue, Suite 306 Leesburg, VA 20176 www.compositepanel.org	703/724-1128
CPSC	Consumer Product Safety Commission 4330 East West Highway Bethesda, MD 20814 www.cpsc.gov	301/504-7923 800/638-2772
CRA	California Redwood Association 405 Enfrente Drive, Suite 200 Novato, CA 94949 www.calredwood.org	415/382-0662

CRI	Carpet and Rug Institute P.O. Box 2048 Dalton, Georgia 30722-2048 www.carpet-rug.org	706/278-3176
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Road Schaumburg, IL 60173 4758 www.crsi.org	847/517-1200
CSI	The Construction Specifications Institute 110 South Union Street, Suite 100 Alexandria VA 22314 www.csinet.org	800/689-2900
CTIOA	Ceramic Tile Institute of America 12061 Jefferson Blvd. Culver City, CA 90230-6219 www.ctioa.org	310/574-7800
DHI	Door and Hardware Institute (formerly National Builders Hardware Association) 14150 Newbrook Dr. Chantilly, VA 20151 www.dhi.org	703/222-2010
DIPRA	Ductile Iron Pipe Research Association 2000 2nd Avenue, South Suite 429 Birmingham, AL 35233 www.dipra.org	205/402-8700
DOC	U.S. Department of Commerce 1401 Constitution Ave., NW Washington, D.C. 20230 www.commerce.gov	202/482-2000
DOT	U.S. Department of Transportation 1200 New Jersey Avenue, SE Washington, DC 20590 www.dot.gov	855/368-4200
EJMA	Expansion Joint Manufacturers Association, Inc. 25 North Broadway Tarrytown, NY 10591 www.ejma.org	914/332-0040

EPA	Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 www.epa.gov	202/272-0167
FCICA	Floor Covering Installation Contractors Association 7439 Millwood Drive West Bloomfield, MI 48322 www.fcica.com	248/661-5015 877/TO-FCICA
FM Global	Factory Mutual Insurance Company Amy Daley Global Practice Leader – Education, Public Entities, Health Care FM Global 270 Central Avenue Johnston, RI 02919-4949 www.fmglobal.com	401/275-3000 401/275-3029
FS	General Services Administration (GSA) Index of Federal Specifications, Standards and Commercial Item Descriptions 470 East L'Enfant Plaza, SW, Suite 8100 Washington, DC 20407 www.gsa.gov	202/619-8925
GA	The Gypsum Association 6525 Belcrest Road, Suite 480 Hyattsville, MD 20782 www.gypsum.org	301/277-8686
GANA	Glass Association of North America 800 SW Jackson St., Suite 1500 Topeka, KS 66612-1200 www.glasswebsite.com	785/271-0208
HMA	Hardwood Manufacturers Association 665 Rodi Road, Suite 305 Pittsburgh, PA 15235 http://hmamembers.org	412/244-0440
HPVA	Hardwood Plywood & Veneer Association 1825 Michael Faraday Drive Reston, Virginia 20190 www.hpva.org	703/435-2900

IAPMO	International Association of Plumbing and Mechanical Officials (formerly the Western Plumbing Officials Association) 4755 E. Philadelphia St. Ontario, CA 91761 www.iapmo.org	909/472-4100
ICC	International Code Council 500 New Jersey Avenue, NW, 6th Floor Washington, DC 20001 www.iccsafe.org	888/422-7233
IEEE	Institute of Electrical and Electronics Engineers 3 Park Avenue, 17th Floor New York, NY 10016-5997 www.ieee.org	212/419-7900
IES	Illuminating Engineering Society 120 Wall Street, Floor 17 New York, NY 10005-4001 www.ies.org	212/248-5000
ITRK	Intertek Testing Services 3933 US Route 11 Cortland, NY 13045 www.intertek.com	607/753-6711
MCAA	Mechanical Contractors Association of America 1385 Piccard Drive Rockville, MD 20850 www.mcaa.org	301/869-5800
MIA	Marble Institute of America 28901 Clemens Rd, Ste 100 Cleveland, OH 44145 www.marble-institute.com	440/250-9222
MMPA (formerly WMMPA)	Moulding & Millwork Producers Association (formerly Wood Moulding & Millwork Producers Association) 507 First Street Woodland, CA 95695 www.wmmpa.com	530/661-9591 800/550-7889

MSS	Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry 127 Park Street, NE Vienna, VA 22180-4602 http://mss-hq.org	703/281-6613
NAAMM	National Association of Architectural Metal Manufacturers 800 Roosevelt Rd. Bldg. C, Suite 312 Glen Ellyn, IL 60137 www.naamm.org	630/942-6591
NAIMA	North American Insulation Manufacturers Association 44 Canal Center Plaza, Suite 310 Alexandria, VA 22314 www.naima.org	703/684-0084
NAPA	National Asphalt Pavement Association 5100 Forbes Blvd. Lanham, MD USA 20706-4407 www.asphaltpavement.org	888/468-6499 301/731-4748
NCSPA	National Corrugated Steel Pipe Association 14070 Proton Road, Suite 100 LB9 Dallas, TX 75244 www.ncspa.org	972/850-1907
NCMA	National Concrete Masonry Association 13750 Sunrise Valley Drive Herndon, VA 20171-4662 www.ncma.org	703/713-1900
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org	301/977-3698
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814 www.necanet.org	301/657-3110
NEMA	National Electrical Manufacturers Association 1300 North 17th Street, Suite 1752 Rosslyn, Virginia 22209 www.nema.org	703/841-3200

NEII	National Elevator Industry, Inc. 1677 County Route 64 P.O. Box 838 Salem, New York 12865-0838 www.neii.org	518/854-3100
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, Massachusetts USA 02169-7471 www.nfpa.org	617/770-3000
NHLA	National Hardwood Lumber Association PO Box 34518 Memphis, TN 38184 www.nhla.com	901/377-1818
NIA	National Insulation Association 12100 Sunset Hills Road, Suite 330 Reston, VA 20190 www.insulation.org	703/464-6422
NRCA	National Roofing Contractors Association 10255 W. Higgins Road, Suite 600 Rosemont, IL 60018-5607 www.nrca.net	847/299-9070
NSF	NSF International P.O. Box 130140 789 N. Dixboro Road Ann Arbor, MI 48113-0140, USA www.nsf.org	800/673-6275 734/769-8010
NTMA	National Terrazzo and Mosaic Association PO Box 2605 Fredericksburg, TX 78624 www.ntma.com	800/323-9736
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational Safety & Health Administration 200 Constitution Ave., NW Washington, D.C. 20210 www.osha.gov	800/321-OSHA (6742)

PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077 or 500 New Jersey Ave., N.W. 7 th Floor Washington, D.C. 20001 www.cement.org	847/966-6200 202/408-9494
PCI	Precast/Prestressed Concrete Institute 200 W. Adams St. #2100 Chicago, IL 60606 www.pci.org	312/786-0300
PDCA	Painting and Decorating Contractors of America 2316 Millpark Drive, Ste 220 Maryland Heights, MO 63043 www.pdca.com	800/332-PDCA (7322) 314/514-7322
PDI	Plumbing & Drainage Institute 800 Turnpike Street, Suite 300 North Andover, MA 01845 http://pdionline.org	978/557-0720 800/589-8956
PEI	Porcelain Enamel Institute, Inc. P.O. Box 920220 Norcross, GA 30010 www.porcelainenamel.com	770/676-9366
PG&E	Pacific Gas & Electric Company www.pge.com	800/743-5000
PLANET	Professional Landcare Network 950 Herndon Parkway, Suite 450 Herndon, Virginia 20170 www.landcarenetwork.org	703/736-9666 800/395-2522 703/736-9668
RFCI	Resilient Floor Covering Institute 115 Broad Street, Suite 201 La Grange GA 30240 www.rfci.com	706/882-3833
RIS	Redwood Inspection Service 818 Grayson Road, Suite 201 Pleasant Hill, CA 94523 www.redwoodinspection.com	925/935-1499
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	847/458-4647

SDI	Steel Door Institute 30200 Detroit Road Westlake, Ohio 44145 www.steeldoor.org	440/899-0010
SJI	Steel Joist Institute 234 W. Cheves Street Florence, SC 29501 http://steeljoist.org	843/407-4091
SMA	Stucco Manufacturers Association 500 East Yale Loop Irvine, CA 92614 www.stuccomfgassoc.com	949/387.7611
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Drive Chantilly, Virginia 20151-1219 www.smacna.org	703/803-2980
SPI	SPI: The Plastics Industry Trade Association, Inc. 1667 K St., NW, Suite 1000 Washington, DC 20006 www.plasticsindustry.org	202/974-5200
SSPC	Society for Protective Coatings (formerly the Steel Structures Painting Council) 40 24th St 6th Fl Pittsburgh, PA 15222 www.sspc.org	412/281-2331 877/281-7772
TCA	The Tile Council of North America 100 Clemson Research Blvd. Anderson, SC 29625 www.tcnatile.com	864/646-8453
TPI	Truss Plate Institute 218 North Lee Street, Suite 312 Alexandria, VA 22314 www.tpinst.org	703/683-1010
TPI	Turfgrass Producers International 2 East Main Street East Dundee, IL 60118 www.turfgrassod.org	800/405-8873 847/649-5555

TCIA	Tree Care Industry Association (formerly the National Arborist Association) 136 Harvey Road, Suite 101 Londonderry, NH 03053 www.tcia.org	800/733-2622
TVI	The Vermiculite Institute c/o The Schundler Company 150 Whitman Avenue Edison, NJ. 08817 www.vermiculiteinstitute.org	732/287-2244
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 www.ul.com	847/272-8800 877/854-3577
UNI	Uni-Bell PVC Pipe Association 2711 LBJ Freeway, Suite 1000 Dallas, TX 75234 www.uni-bell.org	972/243-3902
USDA	U.S. Department of Agriculture 1400 Independence Ave., S.W. Washington, DC 20250 www.usda.gov	202/720-2791
WA	Wallcoverings Association 401 North Michigan Avenue Suite 2200 Chicago, IL 60611 www.wallcoverings.org	312/321-5166

WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281 or 6980 S.W. Varns Tigard, OR 97223 www.wclib.org	503/639-0651
WCMA	Window Covering Manufacturers Association 355 Lexington Avenue 15th Floor New York, New York 10017 www.wcmanet.org	212/297-2122
WDMA	Window & Door Manufacturers Association 401 N. Michigan Avenue, Suite 2200 Chicago, IL 60611 or 2025 M Street, NW, Ste. 800 Washington, D.C. 20036-3309 www.wdma.com	312/321-6802 202/367-1157
WI	Woodwork Institute P.O. Box 980247 West Sacramento, CA 95798 www.wicnet.org	916/372-9943
WRI	Wire Reinforcement Institute 942 Main Street Hartford, CT 06103 www.wirereinforcementinstitute.org	860/240-9545
WWCA	Western Wall & Ceiling Contractors Association 1910 N. Lime St. Orange, California 92865 www.wwcca.org	714/221-5520
WWPA	Western Wood Products Association 522 SW Fifth Ave., Suite 500 Portland, OR 97204-2122 www2.wwpa.org	503/224-3930

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 43 00

MATERIALS AND EQUIPMENT**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Purchase of Materials and Equipment;
- B. Special Conditions;
- C. Imported Materials Certification.

1.02 MATERIAL AND EQUIPMENT

- A. Only items approved by the District and/or Architect shall be used.
- B. Contractor shall submit lists of products and other product information in accordance with the Contract Documents, including, without limitation, the provisions regarding the submittals.

1.03 MATERIAL AND EQUIPMENT COLORS

- A. The District and/or Architect will provide a schedule of colors.
- B. No individual color selections will be made until after approval of all pertinent materials and equipment and after receipt of appropriate samples in accordance with the Contract Documents, including, without limitation, the provisions regarding the submittals.
- C. Contractor shall request priority in writing for any item requiring advance ordering to maintain the approved Construction Schedule.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall deliver manufactured materials in original packages, containers, or bundles (with seals unbroken), bearing name or identification mark of manufacturer.
- B. Contractor shall deliver fabrications in as large assemblies as practicable; where specified as shop-primed or shop-finished, package or crate as required to preserve such priming or finish intact and free from abrasion.
- C. Contractor shall store materials in such a manner as necessary to properly protect them from damage. Materials or equipment damaged by handling, weather, dirt, or from any other cause will not be accepted.

- D. Materials are not acceptable that have been warehoused for long periods of time, stored or transported in improper environment, improperly packaged, inadequately labeled, poorly protected, excessively shipped, deviated from normal distribution pattern, or reassembled.
- E. Contractor shall store material so as to cause no obstructions of sidewalks, roadways, access to the Site or buildings, and underground services. Contractor shall protect material and equipment furnished under Contract.
- F. Contractor may store materials on Site with prior written approval by the District, all material shall remain under Contractor's control and Contractor shall remain liable for any damage to the materials. Should the Project Site not have storage area available, the Contractor shall provide for off-site storage at a bonded warehouse and with appropriate insurance coverage at no cost to District.
- G. When any room in Project is used as a shop or storeroom, the Contractor shall be responsible for any repairs, patching, or cleaning necessary due to that use. Location of storage space shall be subject to prior written approval by District.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers listed in various sections of Contract Documents are names of those manufacturers that are believed to be capable of supplying one or more of items specified therein.
- B. The listing of a manufacturer does not imply that every product of that manufacturer is acceptable as meeting the requirements of the Contract Documents.

2.02 FACILITIES AND EQUIPMENT

Contractor shall provide, install, maintain, and operate a complete and adequate facility for handling, the execution, disposal, and distribution of material and equipment as required for proper and timely performance of Work connected with Contract.

2.03 MATERIAL REFERENCE STANDARDS

Where material is specified solely by reference to "standard specifications" and if requested by District, Contractor shall submit for review data on actual material proposed to be incorporated into Work of Contract listing name and address of vendor, manufacturer, or producer, and trade or brand names of those materials, and data substantiating compliance with standard specifications.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. Where not more specifically described in any other Contract Documents, workmanship shall conform to methods and operations of best standards and accepted practices of trade or trades involved and shall include items of fabrication, construction, or installation regularly furnished or required for completion (including finish and for successful operation, as intended).
- B. Work shall be executed by tradespersons skilled in their respective lines of Work. When completed, parts shall have been durably and substantially built and present a neat appearance.

3.02 COORDINATION

- A. Contractor shall coordinate installation of Work so as to not interfere with installation of others. Adjustment or rework because of Contractor's failure to coordinate will be at no additional cost to District.
- B. Contractor shall examine in-place work for readiness, completeness, fitness to be concealed or to receive other work, and in compliance with Contract Documents. Concealing or covering Work constitutes acceptance of additional cost which will result should in-place Work be found unsuitable for receiving other Work or otherwise deviating from the requirements of the Contract Documents.

3.03 COMPLETENESS

Contractor shall provide all portions of the Work, unless clearly stated otherwise, installed complete and operational with all elements, accessories, anchorages, utility connections, etc., in manner to assure well-balanced performance, in accordance with manufacturer's recommendations and by Contract Documents. For example, electric water coolers require water, electricity, and drain services; roof drains require drain system; sinks fit within countertop, etc. Terms such as "installed complete," "operable condition," "for use intended," "connected to all utilities," "terminate with proper cap," "adequately anchored," "patch and refinish," "to match similar," should be assumed to apply in all cases, except where completeness of functional or operable condition is specifically stated as not required.

3.04 APPROVED INSTALLER OR APPLICATOR

Installation by a manufacturer's approved installer or applicator is an understood part of Specifications and only approved installer or applicator is to provide on-site Work where specified manufacturer has on-going program of approving (i.e. certifying, bonding, re-warranting) installers or applicators. Newly established relationships between a manufacturer and an installer or applicator who does not have other approved applicator work in progress or completed is not approved for this Project.

3.05 MANUFACTURER'S RECOMMENDATIONS

All installations shall be in accordance with manufacturer's published recommendations and specific written directions of manufacturer's representative. Should Contract Documents differ from recommendations of manufacturer or directions of his representative, Contractor shall analyze differences, make recommendations to the District and the Architect in writing, and shall not proceed until interpretation or clarification has been issued by the District and/or the Architect.

END OF DOCUMENT

DOCUMENT 01 45 00

QUALITY CONTROL**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Inspector, Inspections and Tests, Uncovering of Work and Non-conforming of Work and Correction of Work;
- B. Special Conditions.

1.02 RELATED CODES:

- A. The Work is governed by requirements of Title 24, California Code of Regulations ("CCR"), and the Contractor shall keep a copy of these available at the job Site for ready reference during construction.
- B. The Division of the State Architect ("DSA") shall be notified at or before the start of construction.

1.03 OBSERVATION AND SUPERVISION:

- A. The District and Architect or their appointed representatives will review the Work and the Contractor shall provide facilities and access to the Work at all times as required to facilitate this review. Administration by the Architect and any consulting Structural Engineer will be in accordance with applicable regulations, including, without limitation, CCR, Part 1, Title 24, Section 4-341.
- B. One or more Project Inspector(s) approved by DSA and employed by or in contract with the District, referred to hereinafter as the "Project Inspector", will observe the work in accordance with CCR, Part 1, Title 24, Sections 4-333(b) and 4-342:
 - (1) The Project Inspector and Special Inspector(s) shall have access to the Work wherever it is in preparation or progress for ascertaining that the Work is in accordance with the Contract Documents and all applicable code sections. The Contractor shall provide facilities and operation of equipment as needed, and access as required and shall provide assistance for sampling or measuring materials.
 - (2) The Project Inspector will notify the District and Architect and call the attention of the Contractor to any observed failure of Work or material to conform to Contract Documents.

- (3) The Project Inspector shall observe and monitor all testing and inspection activities required.

The Contractor shall conform with all applicable laws as indicated in the Contract Documents, including, without limitation, to CCR, Part 1, Title 24, Section 4-343. The Contractor shall supervise and direct the Work and maintain a competent superintendent on the job who is authorized to act in all matters pertaining to the Work. The Contractor's superintendent shall also inspect all materials, as they arrive, for compliance with the Contract Documents. Contractor shall reject defective Work or materials immediately upon delivery or failure of the Work or material to comply with the Contract Documents. The Contractor shall submit verified reports as indicated in the Contract Documents, including, without limitation, the Specifications and as required by Part 1, Title 24, Section 4-336.

1.04 TESTING AGENCIES:

- A. Testing agencies and tests shall be in conformance with the General Documents and the requirements of Part 1, Title 24, Section 4- 335.
- B. Testing and inspection in connection with earthwork shall be under the direction of the District's consulting soils engineer, if any, referred to hereinafter as the "Soils Engineer."
- C. Testing and inspection of construction materials and workmanship shall be performed by a qualified laboratory, referred to hereinafter as the "Testing Laboratory." The Testing Laboratory shall be under direction of an engineer registered in the State of California, shall conform to requirements of ASTM E329, and shall be employed by or in contract with the District.

1.05 TESTS AND INSPECTIONS:

- A. The Contractor shall be responsible for notifying the District and Project Inspector of all required tests and inspections. Contractor shall notify the District and Project Inspector at least seventy-two hours (72) hours in advance of performing any Work requiring testing or inspection.
- B. The Contractor shall provide access to Work to be tested and furnish incidental labor, equipment, and facilities to facilitate all inspections and tests.
- C. The District will pay for first inspections and tests required by the "CCR", and other inspections or tests that the District and/or the Architect may direct to have made, including the following principal items:
 - (1) Tests and observations for earthwork and paving.
 - (2) Tests for concrete mix designs, including tests of trial batches.
 - (3) Tests and inspections for structural steel work.
 - (4) Field tests for framing lumber moisture content.

- (5) Additional tests directed by the District that establish that materials and installation comply with the Contract Documents.
- (6) Tests and observations of welding and expansion anchors.
- D. The District may at its discretion, pay and then back charge the Contractor for:
 - (1) Retests or reinspections, if required, and tests or inspections required due to Contractor error or lack of required identifications of material.
 - (2) Uncovering of work in accordance with Contract Documents.
 - (3) Testing done on weekends, holidays, and overtime will be chargeable to the Contractor for the overtime portion.
 - (4) Testing done off Site.
- E. Testing and inspection reports and certifications:
 - (1) If initially received by Contractor, Contractor shall provide to each of the following a copy of the agency or laboratory report of each test or inspection or certification.
 - (a) The District;
 - (b) The Construction Manager, if any;
 - (c) The Architect;
 - (d) The Consulting Engineer, if any;
 - (e) Other engineers on the Project, as appropriate;
 - (f) The Project Inspector; and
 - (g) The Contractor.
 - (2) When the test or inspection is one required by the CCR, a copy of the report shall also be provided to the DSA.

PART 2 - PRODUCTS

2.01 TYPE OF TESTS AND INSPECTIONS:

- A. Contractor shall refer to DSA Form 103 (or current version) for all required inspections.
- B. Contractor shall schedule a meeting prior to the commencement of any major construction activities to review DSA Form 103 with the Inspector of Record (IOR), Special Inspection Agency and Construction Manager.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 50 00

TEMPORARY FACILITIES AND CONTROLS**PART 1 – GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions;
- C. Site Standards; and
- D. Construction Waste Management and Disposal.

1.02 TEMPORARY UTILITIES:

- A. Electric Power and Lighting:
 - (1) Contractor will pay for power during the course of the Work. To the extent power is available in the building(s) or on the Site, Contractor may use the District's existing utilities by making prearranged payments to the District for the utilities used by Contractor and all Subcontractors. Contractor shall be responsible for providing temporary facilities required to deliver that power service from its existing location in the building(s) or on the Site to point of intended use.
 - (2) Contractor shall verify characteristics of power available in building(s) or on the Site. Contractor shall take all actions required to make modifications where power of higher voltage or different phases of current are required. Contractor shall be fully responsible for providing that service and shall pay all costs required therefor.
 - (3) Contractor shall furnish, wire for, install, and maintain temporary electrical lights wherever it is necessary to provide illumination for the proper performance and/or observation of the Work: a minimum of 20 foot-candles for rough work and 50 foot-candles for finish work.
 - (4) Contractor shall be responsible for maintaining existing lighting levels in the project vicinity should temporary outages or service interruptions occur.
- B. Heat and Ventilation:
 - (1) Contractor shall provide temporary heat to maintain environmental conditions to facilitate progress of the Work, to meet specified

minimum conditions for the installation and curing of materials, and to protect materials and finishes from damage due to improper temperature and humidity conditions. Portable heaters shall be standard units complete with controls.

- (2) Contractor shall provide forced ventilation and dehumidification, as required, of enclosed areas for proper installation and curing of materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, and gases.
- (3) Contractor shall pay the costs of installation, maintenance, operation, and removal of temporary heat and ventilation, including costs for fuel consumed, required for the performance of the Work.

C. Water:

- (1) Contractor shall pay for water used during the course of the Work. Contractor shall coordinate and pay for installation or use of water meter in compliance with local water agency requirements. To the extent water is then available in the building(s) or on the Site, Contractor may use the District's existing utilities by making prearranged payments to the District for the utilities used by Contractor and all Subcontractors. Contractor shall be responsible for providing temporary facilities required to deliver such utility service from its existing location in the building(s) on the Site, or other location approved by the local water agency, to point of intended use.
- (2) Contractor shall use backflow preventers on water lines at point of connection to District's water supply. Backflow preventers shall comply with requirements of Uniform Plumbing Code.
- (3) Contractor shall make potable water available for human consumption.

D. Sanitary Facilities:

- (1) Contractor shall provide sanitary temporary facilities in no fewer numbers than required by law and such additional facilities as may be directed by the Inspector for the use of all workers. The facilities shall be maintained in a sanitary condition at all times and shall be left at the Site until removal is directed by the Inspector or Contractor completes all other work at the Site.
- (2) Use of toilet facilities in the Work under construction shall not be permitted except by consent of the Inspector and the District.

E. Telephone Service:

- (1) Contractor shall arrange with local telephone service company for telephone service as required for the performance of the Work. Contractor shall, at a minimum, provide in its field office one line for telephone and one line for fax machine.

- (2) Contractor shall pay the costs for telephone and fax lines installation, maintenance, service, and removal.

F. Fire Protection:

- (1) Contractor shall provide and maintain fire extinguishers and other equipment for fire protection. Such equipment shall be designated for use for fire protection only and shall comply with all requirements of the California Fire, State Fire Marshall and/or its designee.
- (2) Where on-site welding and burning of steel is unavoidable, Contractor shall provide protection for adjacent surfaces.

G. Trash Removal:

- (1) Contractor shall provide trash removal on a timely basis. Under no circumstance shall Contractor use District trash service.

H. Field Office:

- (1) If Contractor chooses to provide a field office, it shall be an acceptable construction trailer that is well-lit and ventilated. The construction trailer shall be equipped with shelves, desks, filing cabinet, chairs, and such other items of equipment needed. Trailer and equipment are the property of the Contractor and must be removed from the Site upon completion of the Work.
- (2) Contractor shall provide any additional electric lighting and power required for the trailer. Contractor shall make adequate provisions for heating and cooling as required.

1.03 CONSTRUCTION AIDS:

A. Plant and Equipment:

- (1) Contractor shall furnish, operate, and maintain a complete plant for fabricating, handling, conveying, installing, and erecting materials and equipment; and for conveyances for transporting workers. Include elevators, hoists, debris chutes, and other equipment, tools, and appliances necessary for performance of the Work.
- (2) Contractor shall maintain plant and equipment in safe and efficient operating condition. Damages due to defective plant and equipment, and uses made thereof, shall be repaired by Contractor at no expense to the District.

B. None of the District's tools and equipment shall be used by Contractor for the performance of the Work.

1.04 BARRIERS AND ENCLOSURES:

- A. Contractor shall obtain the District's written permission for locations and types of temporary barriers and enclosures, including fire-rated materials proposed for use, prior to their installation.
- B. Contractor shall provide and maintain temporary enclosures to prevent public entry and to protect persons using other buildings and portions of the Site and/or Premises, the public, and workers. Contractor shall also protect the Work and existing facilities from the elements, and adjacent construction and improvements, persons, and trees and plants from damage and injury from demolition and construction operations.
- C. Contractor shall provide site access to existing facilities for persons using other buildings and portions of the Site, the public, and for deliveries and other services and activities.
- D. Tree and Plant Protection:
 - (1) Contractor shall preserve and protect existing trees and plants on the Premises that are not designated or required to be removed, and those adjacent to the Premises.
 - (2) Contractor shall provide barriers to a minimum height of 4'-0" around drip line of each tree and plant, around each group of trees and plants, as applicable, in the proximity of demolition and construction operations, or as denoted on the Plans.
 - (3) Contractor shall not park trucks, store materials, perform Work or cross over landscaped areas. Contractor shall not dispose of paint thinners, water from cleaning, plastering or concrete operations, or other deleterious materials in landscaped areas, storm drain systems, or sewers. Plant materials damaged as a result of the performance of the Work shall, at the option of the District and at Contractor's expense, either be replaced with new plant materials equal in size to those damaged or by payment of an amount representing the value of the damaged materials as determined by the District.
 - (4) Contractor shall remove soil that has been contaminated during the performance of the Work by oil, solvents, and other materials which could be harmful to trees and plants, and replace with good soil, at Contractor's expense.
 - (5) Excavation around Trees:
 - (a) Excavation within drip lines of trees shall be done only where absolutely necessary and with written permission from the District.
 - (b) Where trenching for utilities is required within drip lines, tunneling under and around roots shall be by hand digging and shall be approved by the District. Main lateral roots and

taproots shall not be cut. All roots 2 inches in diameter and larger shall be tunneled under and heavily wrapped with wet burlap so as to prevent scarring or excessive drying. Smaller roots that interfere with installation of new work may be cut with prior approval by the District. Roots must first be cut with a Vermeer, or equivalent, root cutter prior to any trenching.

- (c) Where excavation for new construction is required within drip line of trees, hand excavation shall be employed to minimize damage to root system. Roots shall be relocated in backfill areas wherever possible. If encountered immediately adjacent to location of new construction, roots shall be cut approximately 6 inches back from new construction.
- (d) Approved excavations shall be carefully backfilled with the excavated materials approved for backfilling. Backfill shall conform to adjacent grades without dips, sunken areas, humps, or other surface irregularities. Do not use mechanical equipment to compact backfill. Tamp carefully using hand tools, refilling and tamping until Final Acceptance as necessary to offset settlement.
- (e) Exposed roots shall not be allowed to dry out before permanent backfill is placed. Temporary earth cover shall be provided, or roots shall be wrapped with four layers of wet, untreated burlap and temporarily supported and protected from damage until permanently relocated and covered with backfill.
- (f) Accidentally broken roots should be sawed cleanly 3 inches behind ragged end.

1.05 SECURITY:

The Contractor shall be responsible for project security for materials, tools, equipment, supplies, and completed and partially completed Work.

1.06 TEMPORARY CONTROLS:

A. Noise Control:

- (1) Contractor acknowledges that adjacent facilities may remain in operation during all or a portion of the Work period, and it shall take all reasonable precautions to minimize noise as required by applicable laws and the Contract Documents.
- (2) Notice of proposed noisy operations, including without limitation, operation of pneumatic demolition tools, concrete saws, and other equipment, shall be submitted to the District a minimum of forty-eight (48) hours in advance of their performance.

B. Noise and Vibration:

- (1) Equipment and impact tools shall have intake and exhaust mufflers.
- (2) Contractor shall cooperate with District to minimize and/or cease the use of noisy and vibratory equipment if that equipment becomes objectionable by its longevity.

C. Dust and Dirt:

- (1) Contractor shall conduct demolition and construction operations to minimize the generation of dust and dirt, and prevent dust and dirt from interfering with the progress of the Work and from accumulating in the Work and adjacent areas including, without limitation, occupied facilities.
- (2) Contractor shall periodically water exterior demolition and construction areas to minimize the generation of dust and dirt.
- (3) Contractor shall ensure that all hauling equipment and trucks carrying loads of soil and debris shall have their loads sprayed with water or covered with tarpaulins, and as otherwise required by local and state ordinance.
- (4) Contractor shall prevent dust and dirt from accumulating on walks, roadways, parking areas, and planting, and from washing into sewer and storm drain lines.

D. Water:

Contractor shall not permit surface and subsurface water, and other liquids, to accumulate in or about the vicinity of the Premises. Should accumulation develop, Contractor shall control the water or other liquid, and suitably dispose of it by means of temporary pumps, piping, drainage lines, troughs, ditches, dams, or other methods.

E. Pollution:

- (1) No burning of refuse, debris, or other materials shall be permitted on or in the vicinity of the Premises.
- (2) Contractor shall comply with applicable regulatory requirements and anti-pollution ordinances during the conduct of the Work including, without limitation, demolition, construction, and disposal operations.

F. Lighting:

- (1) If portable lights are used after dark, all light must be located so as not to direct light into neighboring property.

1.07 JOB SIGN(S):

A. General:

- (1) Contractor shall provide and maintain a Project identification sign with the design, text, and colors designated by the District and/or the Design Professional; locate sign as approved by the District.
- (2) Signs other than the specified Project sign and or signs required by law, for safety, or for egress, shall not be permitted, unless otherwise approved in advance by the District.

B. Materials:

- (1) Structure and Framing: Structurally sound, new or used wood or metal; wood shall be nominal 3/4-inch exterior grade plywood.
- (2) Sign Surface: Minimum 3/4-inch exterior grade plywood.
- (3) Rough Hardware: Galvanized.
- (4) Paint: Exterior quality, of type and colors selected by the District and/or the Design Professional.

C. Fabrication:

- (1) Contractor shall fabricate to provide smooth, even surface for painting.
- (2) Size: 4'-0" x 8'-0", unless otherwise indicated.
- (3) Contractor shall paint exposed surfaces of supports, framing, and surface material with exterior grade paint: one coat of primer and one coat of finish paint.
- (4) Text and Graphics: As indicated.

1.08 PUBLICITY RELEASES:

- A. Contractor shall not release any information, story, photograph, plan, or drawing relating information about the Project to anyone, including press and other public communications medium, including, without limitation, on website(s) without the written permission of the District.

PART 2 – PRODUCTS Not used.

PART 3 – EXECUTION Not used.

END OF DOCUMENT

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Temporary Facilities and Controls.

1.02 SECTION INCLUDES:

- A. Administrative and procedural requirements for the following:
 - (1) Salvaging non-hazardous construction waste.
 - (2) Recycling non-hazardous construction waste.
 - (3) Disposing of non-hazardous construction waste.

1.03 DEFINITIONS:

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS:

- A. General: Develop waste management plan that results in end-of Project rates for salvage/recycling of sixty-five percent (65%) by weight (or by volume, but not a combination) of total waste generated by the Work.

1.05 SUBMITTALS:

- A. Waste Management Plan: Submit waste management plan within 30 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit copies of report. Include the following information:
 - (1) Material category.
 - (2) Generation point of waste.
 - (3) Total quantity of waste in tons or cubic yards.
 - (4) Quantity of waste salvaged, both estimated and actual in tons or cubic yards.
 - (5) Quantity of waste recycled, both estimated and actual in tons or cubic yards.
 - (6) Total quantity of waste recovered (salvaged plus recycled) in tons or cubic yards.
 - (7) Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for final payment, submit copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- H. Qualification Data: For Waste Management Coordinator.
- I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- J. Provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with Calgreen Section 5.408.1.2.
- K. Submittal procedures and quantities are specified in Document 01 33 00.

1.06 QUALITY ASSURANCE:

- A. Waste Management Coordinator Qualifications: LEED Accredited Professional by U.S. Green Building Council.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements. Review methods and procedures related to waste management including, but not limited to, the following:
 - (1) Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - (2) Review requirements for documenting quantities of each type of waste and its disposition.
 - (3) Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - (4) Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - (5) Review waste management requirements for each trade.

1.07 WASTE MANAGEMENT PLAN:

- A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measurement throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
- (1) Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - (2) Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - (3) Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - (4) Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - (5) Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - (6) Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION

3.01 PLAN IMPLEMENTATION:

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - (1) Comply with Document 01 50 00 for operation, termination, and removal requirements.
- B. [Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.]

- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - (1) Distribute waste management plan to everyone concerned within 3 days of submittal return.
 - (2) Distribute waste management plan to entities when they first begin work on site. Review plan procedures and locations established for salvage, recycling, and disposal.

- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - (1) Designate and label specific areas of Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - (2) Comply with Document 01 50 00 for controlling dust and dirt, environmental protection, and noise control.

3.02 RECYCLING CONSTRUCTION WASTE:

- A. General: Recycle paper and beverage containers used by on-site workers.

- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Contractor.

- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - (1) Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project Site. Include list of acceptable and unacceptable materials at each container and bin.
 - (a) Inspect containers and bins for contamination and remove contaminated materials if found.
 - (2) Stockpile processed materials on site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - (3) Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - (4) Store components off the ground and protect from the weather.

- (5) Remove recyclable waste off District property and transport to recycling receiver or processor.
- D. Packaging:
 - (1) Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - (2) Polystyrene Packaging: Separate and bag material.
 - (3) Pallets: As much as possible, require deliveries using pallets to remove pallets from Project Site. For pallets that remain on Site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - (4) Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- E. Site-Clearing Wastes: Chip brush, branches, and trees on site.
- F. Wood Materials:
 - (1) Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - (2) Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- G. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
 - (1) Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.03 DISPOSAL OF WASTE:

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - (1) Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on site.
 - (2) Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off District property and legally dispose of them.

END OF DOCUMENT

DOCUMENT 01 52 13

FIELD OFFICES**PART 1 – GENERAL****1.1 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Temporary Facilities and Controls.

1.2 SECTION INCLUDES:

- A. Requirements for Field Offices and Field Office Trailers.

1.3 SUMMARY:

- A. General: Contractor shall provide District's Field Office Trailer and contents, for District's use exclusively, during the term of the Contract.
- B. Property: Trailer, furniture, furnishings, equipment, and the like, supplied by the Contractor with the Office Trailer shall remain the property of the Contractor; District property items installed, delivered, and the like by District within the Office Trailer will remain District's property.
- C. Modifications: District reserves the right to modify the trailer or contents, or both, as may be deemed proper by District.
- D. Condition: Trailer and contents shall be clean, neat, substantially finished, in good, proper, and safe condition for use, operation, and the like; the trailer and contents shall not be required to be new.
- E. Installation Timing: Provide safe, fully furnished, functional, proper, complete, and finished trailer properly ready for entire use, within fourteen (14) calendar days of District's notification of the issuance of Notice to Proceed.

1.4 SUBMITTALS:

- A. General: Submit submittals to District in quantity, format, type, and the like, as specified herein.
- B. Office Trailer Data: One (1) copy of manufacturer's descriptive data, technical descriptions, regulatory compliance, industry standards, installation, removal, and maintenance instructions.

- C. Equipment Data: Two (2) copies of manufacturer data for each type of equipment, if directed by District.
- D. Furniture and Furnishings Data: Two (2) copies of manufacturer data for each type of equipment, if directed by District.
- E. Plans: One (1) reproducible copy of appropriately scaled plans of trailer layout. Plans shall include, but not be limited to: lighting; furniture; equipment; telephone and electrical outlets; and the like.
- F. Product Samples: One (1) complete and entire unit of each type, if directed by District.

1.5 QUALITY ASSURANCE

- A. Standards: In the event that provisions of codes, regulations, safety orders, Contract Documents, referenced manufacturer’s specifications, manufacturer’s instructions, industry standards, and the like, are in conflict, the more restrictive and higher quality shall govern.
- B. Installer: Installer or Installers engaged by Contractor must have a minimum of five (5) years of documented and properly authenticated successful experience of specialization in the installation of the items or systems, or both, specified herein.
- C. Manufacturer: Contractor shall obtain products from nationally and industry recognized Manufacturer with five (5) years minimum, of immediately recent, continuous, documented and properly authenticated successful experience of specialization in the manufacture of the product specified herein.
- D. State Personnel Training: Provide proper training for maintenance and operations, including emergency procedures, and the like, as directed by District.
- E. Units: Shall be sound and free of defects, and shall not include any damage or defect that will impair the safety, installation, performance, or the durability of the entire Office Trailer and appurtenant systems.

1.6 REGULATORY REQUIREMENTS

- A. General: Work shall be executed in accordance with applicable Codes, Regulations, Statutes, Enactments, Rulings, Laws, each authority having jurisdiction, and including, but not limited to, Regulatory Requirements specified herein.
- B. California Building Standards Code (“CBSC”).
- C. California Code of Regulations, Title 25, Chapter 3, Sub Chapter 2, Article 3 (“CCR”).

- D. Coach Insignia: Trailer shall display California Commercial Coach Insignia; such insignia shall be deemed to show that the trailer is in accordance with the Construction and Fire Safety requirements of CCR.

PART 2 – PRODUCTS

2.1 FIELD OFFICE TRAILER

- A. General: Provide entire Field Office Trailer of type, function, operation, capacity, size, complete with controls, safety devices, accessories, and the like, for proper and durable installation. Partitions, walls, ceiling, and other interior and exterior surfaces shall be appropriately finished, including, but not limited to, trim, painting, wall base, floor covering, suspended or similar ceiling, and the like; provide systems, components, units, nuts, bolts, screws, anchoring devices, fastening devices, washers, accessories, adhesives, sealants, and other items of type, grade, and class required for the particular use, not identified but required for a complete, weather-tight, appropriately operating, and finished installation.
- B. Manufacturers: General Electric Capital Modular Space; The Space Place, Inc.; or equal.
- C. Program: Provide a wheel-mounted trailer with stairs, landings, platforms, ramps, and the like, in good, proper, safe, clean, and properly finished condition; with proper heavy duty locks, and other proper and effective security at all doors, windows, and the like. Trailer shall be maintained in good, proper, safe, clean, and properly finished condition during the Contract.
- (1) Nominal Trailer Size: Four hundred eighty (480) square feet, minimum.
 - (2) Stairs, Platform: Properly finished stairs, platforms, and ramps.
 - (3) Doors: Two (2), three (3) foot wide exterior doors with locksets; finished ramp, steps, and entry platform at each exterior door.
 - (4) Keys: Submit five (5) keys for each door, window, furniture unit, and the like. There shall be no other key copies or originals available; each key shall be identified for District; and shall be labeled, or tagged or both, as directed by District.
 - (5) HVAC: HVAC: Heating and Air-Conditioning for the field office capable of maintaining temperatures between 65 and 75 degrees.
 - (6) Lighting: Sixty-five (65) foot-candles illumination minimum at any point, at thirty (30) inches above finished floor throughout from fluorescent light source, exclusively, or as directed by District.
 - (7) Electrical Outlets: One (1) duplex outlet evenly spaced every twelve (12) linear horizontal feet of wall face, and electrical service ready for use.

- (8) Telephones and Telephone Outlets: Two (2) telephone lines wired, connected to telephone utility service, and ready for use, and two (2) telephone instruments, each with two (2)-line capability, speed dial and hands-free feature. Locate each outlet as directed by District.
- (9) Voicemail Messaging System or Answering Machine: One (1) unit, two (2)-line; digital.
- (10) Data Connection: Contractor should assume that a connection to the local utility provider is required. Provide a router to allow a minimum of six (6) users to connect.

The network shall have the following requirements:

- (a) The internet connection, if provided by the client or subcontractor, shall have at a minimum a 20-Meg upload / 20-Meg download speed. This should be accomplished via a hard-wired connection.
- (b) If it is necessary to "piggyback" off of an existing hard-wired line, the line provided to Kitchell shall be an unfiltered line, with no limitations set by the main line holder, such as access restrictions or DNS port blocking.
- (c) In the cases where a hard-wired connection is not available, the wireless connection provided must meet the same speed needs of 20-Meg upload / 20-Meg download. It shall also be of sufficient bandwidth to meet the needs of the staff.

The equipment required at the site shall be determined by Kitchell Management. However, for an office of three people or more, Kitchell will require:

- (A) A Cisco ASA 5505 network security appliance.
- (B) A Cisco switch.
- (C) Wired network connections to the workspaces for the Kitchell staff.
- (D) A wired network connection to the Printer/Scanner. Reasonable access to power for the equipment.

2.2 FIELD OFFICE TRAILER ITEMS

- A. General: Provide the Field Office Trailer with the following arranged into Four (4) workstations:
 - (1) Desks: Four (4) desks with lockable file storage: thirty-six (36) inches by sixty (60) inches; steel, laminated plastic top; locking, one (1) or two (2) file drawers single pedestal; steel; provide five (5) keys to District.

- (2) Tables: Two (2) tables; thirty-six (36) inches by sixty (60) inches; twenty-nine (29) inches high; steel, laminated plastic top tables; one (1) at each desk.
 - (3) Chairs: Four (4) chairs: swivel; steel; with seat cushion and arms; one (1) at each desk. Ten (10) collapsible chairs for Tables.
 - (4) Waste Baskets: Four (4) waste baskets and Four (4) recycling baskets, one at each desk.
- B. Furniture and Equipment: Provide in the space located to effect efficient and logical use.
- (1) File cabinet: One (1); four (4) drawer; lateral; steel locking.
 - (2) Plan Table: One (1) plan table: thirty-six (36) inches deep by seventy-two (72) inches wide by forty-two (42) inches high; adjustable; wood or steel; with lockable plan and pencil drawers.
 - (3) Drafting Stool: One (1) drafting stool; swiveling; steel; padded; adjustable; with footrest and casters.
 - (4) Bookshelf: One (1) bookshelf: thirty-six (36) inches deep by seventy-two (72) inches wide by forty-two (42) inches high; adjustable; wood or steel; with lockable plan and pencil drawer.
 - (5) Plan Rack: One (1) wheel mounted plan rack.
 - (6) Waste Baskets: One (1) large waste basket.
 - (7) Coat/Hat Hanger: Wall mounted with minimum capacity for four (4) garments and ten (10) hats.
 - (8) Document Management System: Shall include an integrated high-volume printer, copier, and facsimile machine, including stand, base, and storage cabinet; and shall include the following features:
 - (a) Type: Laser, dry electrostatic transfer, plain paper, digital, multi-function imaging system.
 - (b) Network: Ethernet or Token Ring network ready, Plug-and-Play.
 - (c) Print, send/receive facsimile from any connected workstation.
 - (d) Resolution: Six hundred (600) dots per inch by six hundred (600) dots per inch, minimum.
 - (e) Print Speed: Twenty (20) pages per minute, minimum.
 - (f) Copies: Twenty (20) copies per minute, minimum.

- (g) Document Handler: Forty (40) sheet, minimum
- (h) Collator: Forty (40) bin, minimum, with stapling.
- (i) Duplexing: Capable.
- (j) Paper Size: Capable of handling paper sizes to eleven (11) inches by seventeen (17) inches.
- (k) Paper Cassettes: One (1) each for eight and one half (8.5) inches by eleven (11) inches, eight and one half (8.5) inches by fourteen (14) inches, and eleven (11) inches by seventeen (17) inches paper sizes; minimum two hundred fifty (250) sheets per cassette.
- (l) Reduction/Enlargement: Capable of reduction to twenty-five percent (25%) and enlargement to two hundred percent (200%).
- (m) Facsimile Electronic Storage: Capable of storing minimum of fifty (50) speed dial numbers, group faxing and broadcast faxing.
- (n) Facsimile Scanning: Capable of scanning into memory a minimum of one hundred (100) pages with maximum scan time of three (3) seconds per page.
- (o) Halftone: Sixty-four (64) levels.
- (p) Redial: Automatic and Manual.
- (9) Maintenance: Contractor shall purchase service agreements for each unit of equipment for the duration of the project plus two (2) months, and shall maintain all equipment in proper working condition. Service agreements shall include provision for replacement of toner cartridges and other items required to effect proper unit use. Service agreements shall also provide for:
 - (a) Unlimited Service Calls.
 - (b) Same Day Response.
 - (c) All parts, labor, preventative maintenance and mileage.
 - (d) All chemicals, such as toner, fixing agent, and the like.
 - (e) System training and setup.
- (10) Provide an office trailer with restroom facilities inside the trailer.
- (11) Portable Toilets: Two (2); each shall include a urinal; each unit shall be a properly enclosed chemical unit conforming to ANSI Z4.3.

- (a) Location: As directed by District.
- (b) Maintenance: Maintain each unit and surrounding areas in a clean, hygienic and orderly manner, at all time. Empty, clean, and sanitize each unit each day at a location and time as directed by District.
- (c) Removal: Relocate, or remove from the site, each Portable Toilet. Upon such directive by District, the Contractor shall forthwith relocate or remove each Portable Toilet and submit the affected areas to a condition which existed prior to the installation of each Portable Toilet, within three (3) calendar days, or as directed by District in writing, at no cost to District.

(12) Microwave.

(13) Microfridge.

2.3 UTILITY AND SERVICES

- A. Telephone Service: Contractor shall provide and interface the entire telephone service, and shall properly and timely pay for telephone service for District's non-long-distance use.
- B. Electrical Service: Provide all proper connections and continuously pay for service for the duration of the Work.

2.4 FINISHES

- A. General: Manufacturer standard finish system over surfaces properly cleaned, pretreated, and prepared to obtain proper bond; all visible surfaces shall be coated.
- B. Finish: Color as selected by District from manufacturer standard palette.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Properly prepare area and affected items to receive the Work. Set Work accurately in location, alignment, and elevation; rigidly, securely, and firmly anchor to appropriate structure; install plumb, straight, square, level, true, without racking, rigidly anchored to proper solid blocking, substrate, and the like; provide appropriate type and quantity of reinforcements, fasteners, adhesives, self-adhesive and other tapes; lubricants, coatings, accessories, and the like, as required for a complete, structurally rigid, stable, sound, and appropriately finished installation, in accordance with manufacturer's published instructions, and as indicated. The more restrictive and higher quality requirement shall govern. Moving parts shall be properly secured, without binding, looseness, noise, and the like.

- B. Installation: Install in accordance with 25 CCR 3.2.3 and as directed by District; jack up trailer and level both ways; mount on proper concrete piers with all load off wheels; provide required tie down and accessories per Section 4368 of referenced CCR, and as directed by District.
- C. Rejected Work: Work, materials, unit, items, systems, and the like, not accepted by District shall be deemed rejected, and shall forthwith be removed and replaced with proper and new Work, materials, unit, items, systems, and the like at no cost to District.
- D. Standard: Comply with manufacturer's published instructions, or with instructions as shown or indicated; the more restrictive and higher quality requirement shall govern.
- E. Location: As directed by District.
- F. Fire Resistance: Construct and install in accordance with UL requirements.
- G. Maintenance: Contractor shall maintain trailer and adjacent areas in a safe, clean and hygienic condition throughout the duration of the Work, and as directed by District. Properly repair or replace furniture or other items, as directed by District. Properly remove unsafe, damaged, or broken furniture, or similar items, and replace with safe and proper items. Contractor shall pay cost of all services, repair, and maintenance, or replacement of each item.
- H. Janitorial Service: Provide professional janitorial services, including, but not limited to, trash, waste paper baskets, fill paper dispensers; clean and dust all furniture, files, and the like; sweep and mop resilient and similar flooring; and vacuum carpeting and similar flooring.
 - (1) Frequency: Two (2) times per week, minimum.
- I. Removal: Properly remove the Office Trailer and contents from the Site upon completion of the Contract, or as directed by District in writing. Forthwith properly patch and repair affected areas; replace damaged items with new items. Carefully and properly inventory, clean, pack, store, and protect District property; submit District property to District at a date, time and location as directed by District.

END OF DOCUMENT

**SECTION 01 5639
TEMPORARY TREE AND PLANT PROTECTION**

PART 1 GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Furnish all Arborist services, temporary systems, labor, materials, equipment, and apparatus not specifically mentioned herein or noted on the plans, but which are incidental and necessary to complete the work specified for the protection, preservation and/or repair of trees, including care, pruning, and trimming (limbs and roots) as required to construct improvements.

- B. Contractor shall protect from damage all existing vegetation determined by the Owner to remain on the project site and on adjacent property (for trees overhanging the project site).
 - 1. Contractor shall be responsible for the repair any damage, including that to the adjacent property resulting from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly and according to the Owner directions, the Owner may have the necessary work performed and charge the cost to Contractor.

- C. Tree and Plant Protection includes, but is not limited to the following:
 - 1. Protect existing trees and plants scheduled to remain against injury or damage, including cutting, breaking, or skinning of roots, trunks, or branches; soil compaction by stockpiled construction materials, excavated materials or vehicular traffic within the dripline (tree canopy). The work includes but is not limited to the following:
 - a. Protecting existing trees and plants to remain during all phases of construction, including site preparation, excavation, and trenching.
 - b. Erection, maintenance, and removal of temporary tree protection fencing.
 - c. Replacement of trees and plants damaged by work of this Contract.
 - 2. Protective Fencing and Signage surrounding the Tree protection Zone around the tree or group of trees.
 - 3. Pre-Demolition and Construction meetings on site with the Owner.
 - 4. Pre-work Clearance Pruning for demolition and construction.
 - 5. Organic mulch placed in tree protection zones.
 - 6. Irrigation of trees before and during demolition and construction.
 - 7. Dealing with protection and preservation of tree roots relative to soil grubbing, grading, structure or pavement removal, excavations, etc.

1.02 REFERENCES AND STANDARDS

- A. Best Management Practices, Tree Pruning. 2008. International Society of Arboriculture, PO Box 3129, Champaign, IL 61826-3129. 217-355-9411
- B. ANSI A300 Pruning Standards. 2008 Edition. Ibid. (Covers tree care methodology).
- C. ANSI Z133.1 Safety Requirements for Arboricultural Operations. 2006 Edition. Ibid. (Covers safety).
- D. Cooperative Extension U.C., Leaflet 21418, "Tree Evaluation and Casualty Loss".
- E. Arboriculture: The care of trees and shrubs by Dr. Richard Harris

1.03 DEFINITIONS

- A. Certified Arborist: An Arborist certified through the ISA (International Society of Arboriculture) after passing a test demonstrating basic knowledge about urban trees and their management, fulfilling an ongoing continuing education requirement, and paying regularly scheduled certification fees.

- B. Dripline (tree): The area under the total branch spread of the tree, all around the tree.
- C. Existing tree: The trees existing on property prior to any demolition or construction for a project.
- D. Neighboring tree: Existing trees on adjacent private property not owned by the Owner, but the dripline of which overhangs the Owner property.
- E. Qualified Tree Service: A tree service with a supervising arborist who has the minimum certification level of ISA (International Society of Arboriculture) Certified Arborist, in a supervisory position on the job site during execution of the tree work. The tree service shall adhere to the most current of the following arboricultural industry tree care standards.
- F. Tree: a woody perennial plant usually having one dominant trunk and a mature height greater than 15 feet. Multiple-trunk trees have more than one trunk.
- G. Tree Protection Zone (TPZ): The area inside the Tree Protection Fencing on a project, containing the tree or tree trunks and below some or the entire canopy of the tree or beyond the canopy. The TPZ and Tree Protection Fencing remain in place prior to any work on site (including demolition) until the construction project is fully completed.
- H. Tree Service: A company that performs tree pruning and tree removals as their main business.

1.04 QUALITY ASSURANCE

- A. Perform all work in accordance with the above-named references and standards.
- B. Arborist shall be approved by an ISA certified Arborist approved by the Owner with a minimum of 10 years experience.
- C. All tree protection, preservation and pruning performed shall be executed by a Qualified Tree Service company having, in full-time employment, an Arborist certified by the International Society of Arboriculture (ISA). Certification must be verified. The Arborist must be directly responsible for decisions made and should visit the work sites daily when trimming of tree limbs and roots are to be performed.

1.05 SUBMITTALS

- A. Arborist certification
- B. Tree Pruning Schedule (provided by Qualified Tree Service Contractor): Written schedule detailing scope and extent of pruning of trees to remain and that interfere with or are affected by demolition or construction
- C. Contractor shall submit a work plan and schedule for all work adjacent to the existing trees to remain to the Owner for review and approval.

1.06 TAGGING OF TREES TO BE PRESERVED

- A. All preserved trees on site and off site shall be flagged with a distinctive colored ribbon prior to Preconstruction Meeting. After flagging and prior to commencement of any work, the Contractor shall notify the Owner who will verify that the correct trees are flagged.

1.07 PROJECT CONDITIONS

- A. The Contractor will be held responsible for any damage to trees or other plants, which are to remain during construction, including limb or branch breakage, tearing of bark along trunk or excessive root damage. Large roots greater than 3" in diameter shall not be cut without the Owner approval.
- B. The following practices are prohibited within Tree Protection Zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Placement of outhouses

4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Equipment wash down.
8. Grubbing of soil surface to remove organic matter.
9. Disposal of chemicals, petroleum products, or other detrimental substances.
10. Excavation, grading, or other soil disturbance unless otherwise indicated.
11. Attachment of signs to or wrapping materials around trees unless otherwise indicated on plans

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tree Protection Fencing:
 1. Polyethylene Safety Fencing; 48"width; 1 2" mesh opening; color orange; tensile strength 2000 to 2310 psi.
 - a. Posts: 2x4 Douglas Fir or heavy duty punched metal "U" posts; 13-gauge steel.
 - b. Accessories: tie wires, hog ring ties, and other accessories for a complete fence system.
- B. Tree Protection Signs:
 1. Signs shall be 8.5" x 11", aluminum or corrugated plastic.
 2. Signs shall read "WARNING - Tree Protection Zone Keep Out– This fence shall not be removed during construction."
 3. Signs shall be located one for each of the four compass points for single trees.
- C. Mulch
 1. Per planting specifications.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. If at any time the Contractor judges that the protection of a tree designated to be saved on site or off site is incompatible with work required, or if operations necessary threaten the health or structural stability of a tree, notify immediately the Landscape Architect and do no further work affecting the tree until a written agreement is reached concerning acceptable procedures.
- B. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion and sedimentation control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree protection zones.
- C. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- D. Contractor shall install 8 or 9 inch diameter straw wattling roll on the uphill side of the protective fence to divert runoff from the construction site to the protected trees. The wattle shall be maintained until protective fence is removed from the project site.
- E. Under no circumstances shall the Contractor remove existing trees that are indicated not to be removed.
- F. Tree removal may not damage existing trees or vegetation to remain; consult with Owner's Representative regarding any conflicts.

3.02 PROTECTION OF EXISTING TREES AND PLANTS

- A. Tree and Plant Protection Fencing:

1. Install Tree Protection Fencing along edges of Tree Protection Zones in a manner that will prevent people from easily entering protected area except for arborist inspection and tree maintenance. An 18-inch wide gap for arborist access and tree maintenance will be provided in each fenced off area.
 2. Locate fencing as shown on plans or as follows:
 - a. Tree Masses: around entire tree mass at the dripline (edge of tree canopy).
 - b. Single Trees: around drip line of tree.
 3. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Owner.
 4. Protection-Zone Signage: Install Tree Protection Signs every 20 feet or in each cardinal direction, whichever is more, 6 inches from the top of the fence. Signs must be securely attached to fence with 4 plastic wire ties; one tie in each corner.
 5. Erect temporary fencing before commencing any construction work. Maintain fencing during full construction period. Remove temporary fencing when no longer needed or when acceptable to Owner's Representative.
 6. Obtain approval by the Owner's Representative of proposed fencing alignment prior to installation.
 7. Maintain Tree Protection Fencing and signage in good condition as acceptable to Owner and Arborist and remove when construction operations are complete, and equipment and materials have been removed from the site. At sites where the excavation has taken place near trees to remain, and many living roots remain exposed to the air, the Contractor shall cover the exposed roots within 2 hours with sand, soil, moist burlap or other means acceptable to the Owner.
- B. Vehicles, materials storage and excavated materials are not allowed within the fenced areas and/or tree driplines.
1. If access is determined to be necessary, apply a 4-inch deep layer of approved bark mulch over the required area.
 2. If equipment access is required, place interlocking metal matting on top of the bark mulch.
- C. Temporary Systems
1. Existing trees may require fertilizers and/ or bi-weekly temporary irrigation or truck watering at the direction of the project arborist.
- D. Trenching and Excavation:
1. Excavation: All excavations and trenching adjacent to large coniferous trees both on site and offsite (Cedars, Pines, and Redwoods) shall be monitored at all times by the project Arborist.
 2. General: Hand or air spade excavate at edge of Tree Protection Zones for grading, trenches and other soil disturbance adjacent to existing trees.
 3. No rototilling or other soil disturbance shall take place within Tree Protection Zones, before, during, or after demolition or construction, unless designated within construction documents.
 4. Trenching near Trees: Where utility trenches are required within or adjacent to Tree Protection Zones, air spade or hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut large (e.g. 2 inches in diameter or greater) roots; cut only smaller roots that interfere with installation of utilities.
 - a. Mechanical Trenching may be done outside the drip line of a tree or to within 1/3 of the tree's height, whichever is greater.
 - b. Hand trenching is required inside the tree's drip line or within the 1/3 height zone.
 5. Open trenches are not to be routed beneath the dripline of trees that are to be preserved unless this is impossible to avoid; in which case damage may be reduced by careful placement by air spading or hand-digging of trenches to avoid large roots by tunneling under rather than cutting roots greater than 2 inches or greater in diameter.
- E. Root Pruning:
1. Leave large roots exposed during excavation intact if possible, by hand excavating around the root; this is a requirement for roots 4" in diameter and larger.

2. Roots shall be cut cleanly, as far from the trunk of the tree as possible. Root pruning shall be to a depth of 18".
3. Root pruning shall be performed using a Vermeer Root Cutting Machine. Alternate equipment or techniques must be approved by the Arborist and Owner's Landscape Architect.
4. Root pruning shall be completed prior to base or subgrade preparation, or to any excavation adjacent to the tree.
 - a. Root Pruning: Prior to root cutting air spade or hand dig a trench along the edge of the excavation facing the protected tree(s), to the depth of the excavation. The trench must be at least 12 inches wide. Cut exposed roots that need to be removed cleanly back to the trench wall with sharp pruning tools. Do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots. Heavy equipment may be used to continue soil work but the equipment must not contact the roots that have been cut at the edge of the trench, or any soil or roots on the tree-side of the trench.
 - b. Protect cut and exposed roots 1" in diameter and larger from drying. Drape 2 layers of natural burlap from top of trench, covering roots; keep moist until soil backfill is replaced.
 - c. Moisten roots and surrounding soil and cover with a 4" thick layer of bark mulch to prevent desiccation.
 - d. Do not apply pruning seals or paint to the wounds.
 - e. Backfill as soon as possible according to requirements in Section 31 2200 - Earth Work. Wet the backfill soil thoroughly as it is placed in the trench.

F. Tree Pruning:

1. Obtain the approval of the Owner for any pruning of trees required for construction clearance.
2. All pruning work shall be performed by an ISA Certified Arborist or Tree Worker. All work shall be done in accordance with pruning techniques adopted by ISA.
3. Remove branches that are in the path of temporary and permanent construction, or within the work zone margin beyond that construction. Where trees are concerned, minimize the work zone margin to the minimum possible to accomplish demolition or construction work.
4. Tree pruning shall be performed to balance the crown and eliminate hazards. The main work performed shall be to reduce the sail effect through thinning, reducing end weights, shortening long heavy limbs, removing deadwood, weak limbs, and sucker growth. Limbs shall be pruned back to an appropriate lateral branch.
5. All final cuts shall be made at the outer edge of the branch collar. The pruning work shall be performed in a safe and proper manner, adhering to CAL-OSHA and ANSI Standards.
6. The Contractor shall be responsible for the preservation of all public and private property. Pruning includes the cutting of limbs, cleanup, removal and disposal of cuttings and debris. Elm logs must be properly disposed of per State Quarantine. Work shall be performed by a two-person crew with one climber, one ground person, a dumping chipper truck and chipper, and any other necessary saws, lines, tools, and safety equipment. The work area shall have appropriate cones and signs for safe pedestrian and vehicle traffic.

3.03 Repair and Replacement

A. Tree and Plant Repair:

1. Contractor shall repair or replace protected trees and other vegetation indicated to remain or be relocated that are damaged by construction operations at no additional cost to contract or Owner. The Owner shall specify any repair work or replacement value for damaged trees.
2. All repair work shall be performed by an ISA Certified Arborist or Tree Worker. All work shall be done in accordance with techniques adopted by ISA.

B. Tree and Plant Replacement:

1. Replace trees scheduled to remain that are damaged beyond repair by construction operations, as determined by the Owner's Representative, with trees of similar size and species, or by payment of an amount representing the value of the damaged material as

determined by the Owner in accordance with Cooperative Extension U.C., Leaflet 21418,
"Tree Evaluation and Casualty Loss

- C. Repair and replacement of trees and plants scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at Contractor's expense.

3.04 Regrading

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

3.05 Disposal of Surplus and Waste Materials

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

**SECTION 01 6211
DELEGATED DESIGN**

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for Delegated Design components of the Work.
- B. Project Record Requirements

1.02 CONTRACTOR'S DELEGATED DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
 - 1. Structural Design of Metal Framing: As described in Section 05 4000 - Cold-Formed Metal Framing.
 - 2. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 4313 - Aluminum-Framed Storefronts.
 - 3. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 4613 - Glazed Aluminum Window Walls.
 - 4. Structural Calculations for Glazing System: As described in Section 08 8000 - Glazing.
 - 5. Structural Calculations for Framing System: As described in Section 09 2116 - Gypsum Board Assemblies.

1.03 DEFINITIONS

- A. Delegated Design: Certain components of the Work for which Contractor shall coordinate and assume or assign responsibility for design, engineering, calculations, submittals, fabrication, transportation, and installation. (Also called "Design-Build" components).
 - 1. Delegated Design components shall be complete systems that perform their intended functions.
- B. Authorities Having Jurisdiction: Authorities Having Jurisdiction.
- C. Architect or Engineer of Record: ABC Architect or their consulting engineer.

1.04 PERFORMANCE REQUIREMENTS

- A. Permit: Submit design and calculations to the Authorities Having Jurisdiction and secure permit for Delegated Design components:
 - 1. Separate approval is required for each delegated design component.
 - 2. Pay for permit and permit review.
- B. Comply with current codes and regulations, except where more stringent requirements are specified.
- C. Clearly define load reactions at the interface between delegated design components and structural frame to allow review by Owner and Architect.
 - 1. Note loads that are different from loads anticipated in the Contract Documents with special marking.
 - 2. Coordinate connections with appropriate subcontractors.

- D. Provide delegated design components that match as closely as possible to the design indicated in Contract Documents.

1.05 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 3300 - Submittal Procedures.
 - 1. Submit to Owner and Architect prior to submitting to Authorities Having Jurisdiction
 - 2. Architect will return copies for submittal to Authorities Having Jurisdiction with "Reviewed" stamp.
 - 3. Delegated design submittal is in addition to product data, shop drawing and sample submittals.

- B. Indicate design criteria, design assumptions, details, calculations, submittals, instructions for fabrication, assembly, installation and interface with other trades, unless noted otherwise in the specific Specification Section.

- C. Design and Calculations: Engineer's seal and calculations for that portion of Work.
 - 1. Submittals without required calculations, Delegated Design Engineer's seal, or which have not been reviewed by Contractor will not be reviewed by Architect or Engineer of Record.

- D. Authorities Having Jurisdiction Requirements:
 - 1. Comply with Authorities Having Jurisdiction policies regarding delegated design components of building projects.
 - 2. Three sets of design drawings clearly and legibly showing systems, components, members, dimensions, connections, materials used, and indicating how the part is attached to the main structure.
 - a. Drawings shall be prepared, designed, and sealed by an Engineer licensed by the the State in which the Project is located to practice as such.
 - b. Shop drawings or erection drawings are not acceptable as delegated design drawings.
 - 3. One set of calculations including criteria, design assumptions, substantiating computations, and such additional data sufficient to show the correctness of the plans and compliance with the structural provisions of the Building Code
 - a. Calculations shall be prepared and sealed by the Delegated Design Engineer who prepared and sealed the drawings.
 - 4. Submit Contractor Design Summary Sheet listing Delegated Design Subcontractors and their registered Delegated Design Engineer's name and phone number prior to main permit issuance.

- E. Architect's or Engineer of Record's review of delegated design submittals will be for design intent and shall not lessen nor shift responsibility from Contractor or assigned subcontractor to Owner nor to Architect or Engineer of Record.

- F. Project Record Documents and electronic format requirements for delegated design components and systems
 - 1. Provide the Owner with 2 copies of Record Document drawings and specifications in electronic form on CD Rom as follows:
 - a. Content:
 - 1) Record Documents shall contain revisions made to project by addenda, change orders, shop drawing review and other modifications. The files shall provide the following:
 - (a) Updated delegated design CAD files indicating as-built conditions.
 - (b) Add the following, (see Format):
 - (1) Measured horizontal and vertical dimensions and locations of delegated design components and systems.
 - (2) Measured locations of appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - (3) Field changes of dimensions and details.

- (4) Details not on original Contract Drawings and associated with delegated design.
 - (5) Note to be included on each Sheet of Record Documents: "Project Record Documents - This document has been prepared using information furnished by (list Design Source Contractor Name, date, etc.)."
- b. Format:
- 1) Files saved in latest AutoCAD format.
 - 2) External reference files are to be bound, but need not be exploded.
 - 3) There should be only one file for each and every drawing sheet. The file name will include the sheet number. For example A41.dwg., E32 dwg. or L2 dwg., include the Architects' project number.
 - 4) No more than one Paper Space layout per drawing. Files are to be saved as they should look ready to plot, and shall match the plotted Record Documents.
 - 5) Put information added to CAD files, such as measured depths of foundations and utility location dimensions, on a separate layer. These are to begin with an X, for example "X-GenC-Note" for notes, or "X-GenC-Dims" for dimensions.
 - 6) Locate other CAD information modified or moved on its original layers.

1.06 QUALITY ASSURANCE

- A. Documentation: Comply with the following:
 - 1. Uniform Drawing System.
 - 2. Minimum text size: 1/8 inch (3.17 mm).
 - 3. Legible when microfilmed.
 - 4. Other requirements by Authorities Having Jurisdiction.
- B. Design Requirements: Refer to requirements within individual specification sections.
- C. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in the State in which the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of Delegated Design components that are similar to those indicated for this Project in material, design, and extent.
- D. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.

1.07 SCHEDULING AND COORDINATION

- A. Submit material required by Authorities Having Jurisdiction so that Authorities Having Jurisdiction's review will not adversely affect construction schedule.
 - 1. Prior to submittal, meet with Authorities Having Jurisdiction to identify delegated design components and review submittal requirements.
- B. Completed submission of delegated design documents prior to issuance of building permit, when required by Authorities Having Jurisdiction.
 - 1. Permit for Delegated Design must be issued and paid prior to fabrication.
- C. Owner will not be responsible for paying for delays, additional products, additional hours of work, overtime, restocking or rework required due to failure to coordinate delegated design work or to execute delegated design work in a timely manner.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

DOCUMENT 01 64 00

OWNER-FURNISHED PRODUCTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Materials and Equipment.

1.02 SECTION INCLUDES

- A. Requirements for the following:
 - (1) Installing Owner-furnished materials and equipment.
 - (2) Providing necessary utilities, connections and rough-ins.

1.03 DEFINITIONS

- A. Owner: District, who is providing/furnishing materials and equipment.
- B. Installing Contactor: Contractor, who is installing the materials and equipment furnished by the Owner.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Receive, store and handle products in accordance with the manufacturer's instructions.
- B. Protect equipment items as required to prevent damage during storage and construction.

PART 2 – PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

- A. Installing Contractor's Responsibilities:
 - (1) Verify mounting and utility requirements for Owner-furnished materials and equipment items.

Provide mounting and utility rough in for all items where required.

- (a) Rough in locations, sizes, capacities, and similar type items shall be as indicated and required by product manufacturer.
- B. Owner and Installing Contractor(s) Responsibilities:
- (1) Owner-Furnished/Contractor Installed ("OFCI"): Furnished by the Owner; installed by the Installing Contractor.
 - (a) General: Owner and Installing Contractor(s) will coordinate deliveries of materials and equipment to coincide with the construction schedule.
 - (b) The Owner furnishing specified materials and equipment is responsible to provide manufacturer guarantees as required by the Contract to the Installing Contractor.
 - (c) The Installing Contractor shall:
 - 1) Review, verify and accept the approved manufacturer's submittal/Shop Drawings for all materials and equipment required to be installed by the Installing Contractor and furnished by the Owner. Any discrepancies, including but not limited to possible space conflicts, should be brought to the attention of the Project Manager and/or Program Manager, if applicable.
 - 2) Coordinate timely delivery. Installing Contractor shall receive materials and equipment at Site when delivered and give written receipt at time of delivery, noting visible defects or omissions; if such declaration is not given, the Installing Contractor shall assume responsibility for such defects and omissions.
 - 3) Store materials and equipment until ready for installation and protect from loss and damage. Installing Contractor is responsible for providing adequate storage space.
 - 4) Coordinate with other bid package contractors and field measurement to ensure complete installation.
 - 5) Uncrate, assemble, and set in place.
 - 6) Provide adequate supports.
 - 7) Install materials and equipment in accordance with manufacturer's recommendations, instructions, and Shop Drawings, supply labor and material required, and make mechanical, plumbing, and electrical connections required to operate equipment.

- 8) Be certified by equipment manufacturer for installation of the specific equipment supplied by the Owner.
 - 9) Provide anchorage and/or bracing as required for seismic restraint per Title 24, UBC Standard 27-11 and all other applicable codes.
 - 10) Provide the contract-required warranty and guarantee for all work, materials and equipment, and installation upon its completion and acceptance by the District. Guarantee includes all costs associated with the removal, shipping to and from the Site, and re-installation of any equipment found to be defective.
- C. Compatibility with Space and Service Requirements:
- (1) Equipment items shall be compatible with space limitations indicated and as shown on the Contract Documents and specified in other sections of the Specifications.
 - (2) Modifications to equipment items required to conform to space limitations specified for rough in shall not cause additional cost to the District.
- D. Manufacturer's printed descriptions, specifications, and instructions shall govern the Work unless specifically indicated or specified otherwise.

2.02 FURNISHED MATERIALS AND EQUIPMENT

- A. All furnished materials and equipment are indicated or scheduled on the Contract Documents.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install equipment items in accordance with the manufacturer's instructions.
- B. Set equipment items securely in place, rigidly or flexibly mounted in accordance with manufacturers' directions.
- C. Make electrical and mechanical connections as indicated and required.
- D. Touch-up and restore damaged or defaced finishes to the Owner's satisfaction.

3.02 CLEANING AND PROTECTION

- A. Repair or replace items not acceptable to the Architect or Owner.

- B. Upon completion of installation, clean equipment items in accordance with manufacturer's recommendations, and protect from damage until final acceptance of the Work by the Owner.

END OF DOCUMENT

SECTION 01 66 00

PRODUCT DELIVERY, STORAGE AND HANDLING**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Site Access, Conditions and Requirements;
- B. Special Conditions.

1.02 PRODUCTS

- A. Products are as defined in the General Conditions.
- B. Contractor shall not use and/or reuse materials and/or equipment removed from existing Premises, except as specifically permitted by the Contract Documents.
- C. Contractor shall provide interchangeable components of the same manufacturer, for similar components.

1.03 TRANSPORTATION AND HANDLING

- A. Contractor shall transport and handle Products in accordance with manufacturer's instructions.
- B. Contractor shall promptly inspect shipments to confirm that Products comply with requirements, quantities are correct, and products are undamaged.
- C. Contractor shall provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

- A. Contractor shall store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Contractor shall store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated Products, Contractor shall place on sloped supports, above ground.
- C. Contractor shall provide off-site storage and protection when Site does not permit on-site storage or protection.

- D. Contractor shall cover products subject to deterioration with impervious sheet covering and provide ventilation to avoid condensation.
- E. Contractor shall store loose granular materials on solid flat surfaces in a well-drained area and prevent mixing with foreign matter.
- F. Contractor shall provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- G. Contractor shall arrange storage of Products to permit access for inspection and periodically inspect to assure Products are undamaged and are maintained under specified conditions.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 71 23

FIELD ENGINEERING**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Site Investigation, and Soils Investigation Report;
- B. Special Conditions;
- C. Site-Visit Certification.

1.02 REQUIREMENTS INCLUDED:

- A. Contractor shall provide and pay for field engineering services by a California-registered engineer, required for the project, including, without limitations:
 - (1) Survey work required in execution of the Project.
 - (2) Civil or other professional engineering services specified, or required to execute Contractor's construction methods.

1.03 QUALIFICATIONS OF SURVEYOR OR ENGINEERS:

Contractor shall only use a qualified licensed engineer or registered land surveyor, to whom District makes no objection.

1.04 SURVEY REFERENCE POINTS:

- A. Existing basic horizontal and vertical control points for the Project are those designated on the Drawings.
- B. Contractor shall locate and protect control points prior to starting Site Work and preserve all permanent reference points during construction. In addition Contractor shall:
 - (1) Make no changes or relocation without prior written notice to District and Architect.
 - (2) Report to District and Architect when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - (3) Require surveyor to replace Project control points based on original survey control that may be lost or destroyed.

1.05 RECORDS:

Contractor shall maintain a complete, accurate log of all control and survey work as it progresses.

1.06 SUBMITTALS:

- A. Contractor shall submit name and address of Surveyor and Professional Engineer to District and Architect prior to its/their work on the Project.
- B. On request of District and Architect, Contractor shall submit documentation to verify accuracy of field engineering work, at no additional cost to the District.
- C. Contractor shall submit a certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance or nonconformance with Contract Documents.

PART 2 – PRODUCTS Not Used.

PART 3 - EXECUTION

3.01 COMPLIANCE WITH LAWS:

Contractor is responsible for meeting all applicable codes, OSHA, safety and shoring requirements.

3.02 NONCONFORMING WORK:

Contractor is responsible for any re-surveying required by correction of nonconforming work.

END OF DOCUMENT

DOCUMENT 01 73 29

CUTTING AND PATCHING**PART 1 – GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Inspector, Inspections, and Tests, Integration of Work, Nonconforming Work, and Correction of Work, and Uncovering Work;
- B. Special Conditions;
- C. Hazardous Materials Procedures and Requirements;
- D. Hazardous Materials Certification;
- E. Lead-Based Paint Certification;
- F. Imported Materials Certification.

1.02 CUTTING AND PATCHING:

- A. Contractor shall be responsible for all cutting, fitting, and patching, including associated excavation and backfill, required to complete the Work or to:
 - (1) Make several parts fit together properly.
 - (2) Uncover portions of Work to provide for installation of ill-timed Work.
 - (3) Remove and replace defective Work.
 - (4) Remove and replace Work not conforming to requirements of Contract Documents.
 - (5) Remove Samples of installed Work as specified for testing.
 - (6) Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.
 - (7) Attaching new materials to existing remodeling areas – including painting (or other finishes) to match existing conditions.
- B. In addition to Contract requirements, upon written instructions from the District, Contractor shall uncover Work to provide for observations of covered Work in accordance with the Contract Documents; remove samples of

installed materials for testing as directed by District; and remove Work to provide for alteration of existing Work.

- C. Contractor shall not cut or alter Work, or any part of it, in such a way that endangers or compromises the integrity of the Work, the Project, or work of others.

1.03 SUBMITTALS:

- A. Prior to any cutting or alterations that may affect the structural safety of Project, or work of others, and well in advance of executing such cutting or alterations, Contractor shall submit written notice to District pursuant to the applicable notice provisions of the Contract Documents, requesting consent to proceed with the cutting or alteration, including the following:
 - (1) The work of the District or other trades.
 - (2) Structural value or integrity of any element of Project.
 - (3) Integrity or effectiveness of weather-exposed or weather-resistant elements or systems.
 - (4) Efficiency, operational life, maintenance or safety of operational elements.
 - (5) Visual qualities of sight-exposed elements.
- B. Contractor's Request shall also include:
 - (1) Identification of Project.
 - (2) Description of affected Work.
 - (3) Necessity for cutting, alteration, or excavations.
 - (4) Affects of Work on District, other trades, or structural or weatherproof integrity of Project.
 - (5) Description of proposed Work:
 - (a) Scope of cutting, patching, alteration, or excavation.
 - (b) Trades that will execute Work.
 - (c) Products proposed to be used.
 - (d) Extent of refinishing to be done.
 - (6) Alternates to cutting and patching.
 - (7) Cost proposal, when applicable.

- (8) The scheduled date the Contractor intends to perform the Work and the duration of time to complete the Work.
- (9) Written permission of District or other District contractor(s) whose work will be affected.

1.04 QUALITY ASSURANCE:

- A. Contractor shall ensure that cutting, fitting, and patching shall achieve security, strength, weather protection, appearance for aesthetic match, efficiency, operational life, maintenance, safety of operational elements, and the continuity of existing fire ratings.
- B. Contractor shall ensure that cutting, fitting, and patching shall successfully duplicate undisturbed adjacent profiles, materials, textures, finishes, colors, and that materials shall match existing construction. Where there is dispute as to whether duplication is successful or has been achieved to a reasonable degree, the District's decision shall be final.

1.05 PAYMENT FOR COSTS:

- A. Cost caused by ill-timed or defective Work or Work not conforming to Contract Documents, including costs for additional services of the District, its consultants, including but not limited to the Construction Manager, the Architect, the Project Inspector(s), Engineers, and Agents, will be paid by Contractor and/or deducted from the Contract by the District.
- B. District shall only pay for cost of Work if it is part of the original Contract Price or if a change has been made to the contract in compliance with the provisions of the General Conditions. Cost of Work performed upon instructions from the District, other than defective or nonconforming Work, will be paid by District on approval of written Change Order. Contractor shall provide written cost proposals prior to proceeding with cutting and patching.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Contractor shall provide for replacement and restoration of Work removed. Contractor shall comply with the Contract Documents and with the Industry Standard(s), for the type of Work, and the Specification requirements for each specific product involved. If not specified, Contractor shall first recommend a product of a manufacturer or appropriate trade association for approval by the District.
- B. Materials to be cut and patched include those damaged by the performance of the Work.

PART 3 – EXECUTION

3.01 INSPECTION:

- A. Contractor shall inspect existing conditions of the Site and the Work, including elements subject to movement or damage during cutting and patching, excavating and backfilling. After uncovering Work, Contractor shall inspect conditions affecting installation of new products.
- B. Contractor shall report unsatisfactory or questionable conditions in writing to District as indicated in the General Conditions and shall proceed with Work as indicated in the General Conditions by District.

3.02 PREPARATION:

- A. Contractor shall provide shoring, bracing and supports as required to maintain structural integrity for all portions of the Project, including all requirements of the Project.
- B. Contractor shall provide devices and methods to protect other portions of Project from damage.
- C. Contractor shall, provide all necessary protection from weather and extremes of temperature and humidity for the Project, including without limitation, any work that may be exposed by cutting and patching Work. Contractor shall keep excavations free from water.

3.03 ERECTION, INSTALLATION AND APPLICATION:

- A. With respect to performance, Contractor shall:
 - (1) Execute fitting and adjustment of products to provide finished installation to comply with and match specified tolerances and finishes.
 - (2) Execute cutting and demolition by methods that will prevent damage to other Work, and provide proper surfaces to receive installation of repairs and new Work.
 - (3) Execute cutting, demolition excavating, and backfilling by methods that will prevent damage to other Work and damage from settlement.
- B. Contractor shall employ original installer or fabricator to perform cutting and patching for:
 - (1) Weather-exposed surfaces and moisture-resistant elements such as roofing, sheet metal, sealants, waterproofing, and other trades.
 - (2) Sight-exposed finished surfaces.
- C. Contractor shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances,

and finishes as shown or specified in the Contract Documents including, without limitation, the Drawings and Specifications.

- D. Contractor shall fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Contractor shall conform to all Code requirements for penetrations or the Drawings and Specifications, whichever calls for a higher quality or more thorough requirement. Contractor shall maintain integrity of both rated and non-rated fire walls, ceilings, floors, etc.
- E. Contractor shall restore Work which has been cut or removed. Contractor shall install new products to provide completed Work in accordance with requirements of the Contract Documents and as required to match surrounding areas and surfaces.
- F. Contractor shall refinish all continuous surfaces to nearest intersection as necessary to match the existing finish to any new finish.

END OF DOCUMENT

DOCUMENT 01 76 00

ALTERATION PROJECT PROCEDURES**PART 1 – GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Integration of Work, Purchase of Materials and Equipment, Uncovering of Work and Non-conforming Work and Correction of Work and Trenches;
- B. Special Conditions.

PART 2 - PRODUCTS**2.01 PRODUCTS FOR PATCHING AND EXTENDING WORK:**

- A. New Materials: As specified in the Contract Documents including, without limitation, in the Specifications, Contractor shall match existing products, conditions, and work for patching and extending work.
- B. Type and Quality of Existing Products: Contractor shall determine by inspection, by testing products where necessary, by referring to existing conditions and to the Work as a standard.

PART 3 - EXECUTION**3.01 EXAMINATION:**

- A. Contractor shall verify that demolition is complete and that areas are ready for installation of new Work.
- B. By beginning restoration Work, Contractor acknowledges and accepts the existing conditions.

3.02 PREPARATION:

- A. Contractor shall cut, move, or remove items as necessary for access to alterations and renovation Work. Contractor shall replace and restore these at completion.
- B. Contractor shall remove unsuitable material not as salvage unless otherwise indicated in the Contract Documents. Unsuitable material may include, without limitation, rotted wood, corroded metals, and deteriorated masonry and concrete. Contractor shall replace materials as specified for finished Work.

- C. Contractor shall remove debris and abandoned items from all areas of the Site and from concealed spaces.
- D. Contractor shall prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.
- E. Contractor shall close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity. Contractor shall insulate ductwork and piping to prevent condensation in exposed areas. Contractor shall insulate building cavities for thermal and/or acoustical protection, as detailed.

3.03 INSTALLATION:

- A. Contractor shall coordinate Work of all alternations and renovations to expedite completion and to accommodate District occupancy.
- B. Designated Areas and Finishes: Contractor shall complete all installations in all respects, including operational, mechanical work and electrical work.
- C. Contractor shall remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring Products and finishes to original or specified condition.
- D. Contractor shall refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat and square or straight transition to adjacent finishes.
- E. Contractor shall install products as specified in the Contract Documents, including without limitation, the Specifications.

3.04 TRANSITIONS:

- A. Where new Work abuts or aligns with existing, Contractor shall perform a smooth and even transition. Patched Work must match existing adjacent work in texture and appearance.
- B. When finished surfaces are cut so that a smooth transition with new Work is not possible, Contractor shall terminate existing surface along a straight line at a natural line of division and make a recommendation for resolution to the District and the Architect for review and approval.

3.05 ADJUSTMENTS:

- A. Where removal of partitions or walls results in adjacent spaces becoming one, Contractor shall rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- B. Where a change of plane of 1/4 inch or more occurs, Contractor shall submit a recommendation for providing a smooth transition to the District and the Architect for review and approval.

- C. Contractor shall trim and seal existing wood doors and shall trim and paint metal doors as necessary to clear new floor finish and refinish trim as required.
- D. Contractor shall fit Work at penetrations of surfaces.

3.06 REPAIR OF DAMAGED SURFACES:

- A. Contractor shall patch or replace portions of existing surfaces, which are damaged, lifted, discolored, or showing other imperfections, in the area where the Work is performed.
- B. Contractor shall repair substrate prior to patching finish.

3.07 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS:

- A. Cultivated or planted areas and other surface improvements which are damaged by actions of the Contractor shall be restored by Contractor to their original condition or better, where indicated.
- B. Contractor shall protect and replace, if damaged, all existing guard posts, barricades, and fences.
- C. Contractor shall give special attention to avoid damaging or killing trees, bushes and/or shrubs on the Premises and/or identified in the Contract Documents, including without limitation, the Drawings.

3.08 FINISHES:

- A. Contractor shall finish surfaces as specified in the Contract Documents, including without limitations, the provisions of all Divisions of the Specifications.
- B. Contractor shall finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, Contractor shall refinish entire surface to nearest intersections.

3.09 CLEANING:

- A. Contractor shall continually clean the Site and the Premises as indicated in the Contract Documents, including without limitation, the provisions in the General Conditions and the Specifications regarding cleaning.

END OF DOCUMENT

DOCUMENT 01 77 00

CONTRACT CLOSEOUT AND FINAL CLEANING**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Completion of Work;
- B. Special Conditions;
- C. Temporary Facilities and Controls.

1.02 CLOSEOUT PROCEDURES

Contractor shall comply with all closeout provisions as indicated in the General Conditions.

1.03 FINAL CLEANING

- A. Contractor shall execute final cleaning prior to final inspection.
- B. Contractor shall clean interior and exterior glass and all surfaces exposed to view; remove temporary labels, tape, stains, and foreign substances, polish transparent and glossy surfaces, wax and polish new vinyl floor surfaces, vacuum carpeted and soft surfaces.
- C. Contractor shall clean equipment and fixtures to a sanitary condition.
- D. Contractor shall replace filters of operating equipment.
- E. Contractor shall clean debris from roofs, gutters, down spouts, and drainage systems.
- F. Contractor shall clean Site, sweep paved areas, and rake clean landscaped surfaces.
- G. Contractor shall remove waste and surplus materials, rubbish, and construction facilities from the Site and surrounding areas.

1.04 ADJUSTING

Contractor shall adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 RECORD DOCUMENTS AND SHOP DRAWINGS

- A. Contractor shall legibly mark each item to record actual construction, including:
 - (1) Measured depths of foundation in relation to finish floor datum.
 - (2) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permit surface improvements.
 - (3) Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - (4) Field changes of dimension and detail.
 - (5) Details not on original Contract Drawings
 - (6) Changes made by modification(s).
 - (7) References to related Shop Drawings and modifications.
- B. Contractor will provide one set of Record Drawings to District.
- C. Contractor shall submit all required documents to District and/or Architect prior to or with its final Application for Payment.

1.06 INSTRUCTION OF DISTRICT PERSONNEL

- A. Before final inspection, at agreed upon times, Contractor shall instruct District's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. For equipment requiring seasonal operation, Contractor shall perform instructions for other seasons within six months or by the change of season.
- C. Contractor shall use operation and maintenance manuals as basis for instruction. Contractor shall review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Contractor shall prepare and insert additional data in Operation and Maintenance Manual when the need for such data becomes apparent during instruction.
- E. Contractor shall review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Contractor shall provide products, spare parts, maintenance, and extra materials in quantities specified in the Specifications and in Manufacturer's recommendations.

- B. Contractor shall provide District with all required Operation and Maintenance Data at one time. Partial or piecemeal submissions of Operation and Maintenance Data will not be accepted.

PART 2 – PRODUCTS Not used.

PART 3 – EXECUTION Not used.

END OF DOCUMENT

DOCUMENT 01 78 23

OPERATION AND MAINTENANCE DATA**PART 1 – GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Completion of the Work;
- B. Special Conditions.

1.02 QUALITY ASSURANCE:

Contractor shall prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.03 FORMAT:

- A. Contractor shall prepare data in the form of an instructional manual entitled "OPERATIONS AND MAINTENANCE MANUAL & INSTRUCTIONS" ("Manual").
- B. Manuals and Instructions to be submitted in both PDF and hard copy formats.
- C. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size. When multiple binders are used, Contractor shall correlate data into related consistent groupings.
- D. Cover: Contractor shall identify each binder with typed or printed title "OPERATION AND MAINTENANCE MANUAL & INSTRUCTIONS"; and shall list title of Project and identify subject matter of contents.
- E. Contractor shall arrange content by systems process flow under section numbers and sequence of Table of Contents of the Contract Documents.
- F. Contractor shall provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- G. Text: The content shall include Manufacturer's printed data, or typewritten data on 24 pound paper.
- H. Drawings: Contractor shall provide with reinforced punched binder tab and shall bind in with text; folding larger drawings to size of text pages.
- I. Contractor will also submit the "OPERATIONS AND MAINTENANCE MANUAL & INSTRUCTIONS" (Manual) electronically (in PDF format) at the completion of the Project.

1.04 CONTENTS, EACH VOLUME:

- A. Table of Contents: Contractor shall provide title of Project; names, addresses, and telephone numbers of the Architect, any engineers, subconsultants, Subcontractor(s), and Contractor with name of responsible parties; and schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: Contractor shall list names, addresses, and telephone numbers of Subcontractor(s) and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Contractor shall mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Contractor shall supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Contractor shall not use Project Record Documents as maintenance drawings.
- E. Text: The Contractor shall include any and all information as required to supplement product data. Contractor shall provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- F. Warranties and Bonds: Contractor shall bind in one copy of each.

1.05 MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Contractor shall include product data, with catalog number, size, composition, and color and texture designations. Contractor shall provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Contractor shall include Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Weather Exposed Products: Contractor shall include product data listing applicable reference standards, chemical composition, and details of installation. Contractor shall provide recommendations for inspections, maintenance, and repair.
- D. Additional Requirements: Contractor shall include all additional requirements as specified in the Specifications.
- E. Contractor shall provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. Each Item of Equipment and Each System: Contractor shall include description of unit or system, and component parts and identify function, normal operating characteristics, and limiting conditions. Contractor shall include performance curves, with engineering data and tests, and complete nomenclature, and commercial number of replaceable parts.
- B. Panelboard Circuit Directories: Contractor shall provide electrical service characteristics, controls, and communications.
- C. Contractor shall include color coded wiring diagrams as installed.
- D. Operating Procedures: Contractor shall include start-up, break-in, and routine normal operating instructions and sequences. Contractor shall include regulation, control, stopping, shut-down, and emergency instructions. Contractor shall include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Contractor shall include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Contractor shall provide servicing and lubrication schedule, and list of lubricants required.
- G. Contractor shall include manufacturer's printed operation and maintenance instructions.
- H. Contractor shall include sequence of operation by controls manufacturer.
- I. Contractor shall provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Contractor shall provide control diagrams by controls manufacturer as installed.
- K. Contractor shall provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Contractor shall provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Contractor shall provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- N. Additional Requirements: Contractor shall include all additional requirements as specified in Specification(s).
- O. Contractor shall provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.07 SUBMITTAL:

- A. Contractor shall submit to the District for review two (2) copies of preliminary draft or proposed formats and outlines of the contents of the Manual within thirty (30) days of Contractor's start of Work.
- B. For equipment, or component parts of equipment put into service during construction and to be operated by District, Contractor shall submit draft content for that portion of the Manual within ten (10) days after acceptance of that equipment or component.
- C. Contractor shall submit two (2) copies of a complete Manual in final form prior to final Application for Payment. Copy will be returned with Architect/Engineer comments. Contractor must revise the content of the Manual as required by District prior to District's approval of Contractor's final Application for Payment.
- D. Contractor must submit two (2) copies of revised Manual in final form within ten (10) days after final inspection.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 78 36

WARRANTIES**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions, including, without limitation, Warranty/Guarantee Information;
- B. Special Conditions.

1.02 FORMAT

- A. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size.
- B. Cover: Contractor shall identify each binder with typed or printed title "WARRANTIES" and shall list title of Project.
- C. Table of Contents: Contractor shall provide title of Project; name, address, and telephone number of Contractor and equipment supplier; and name of responsible principal. Contractor shall identify each item with the number and title of the specific Specification, document, provision, or section in which the name of the product or work item is specified.
- D. Contractor shall separate each warranty with index tab sheets keyed to the Table of Contents listing, providing full information and using separate typed sheets as necessary. Contractor shall list each applicable and/or responsible Subcontractor(s), supplier(s), and/or manufacturer(s), with name, address, and telephone number of each responsible principal(s).
- E. Contractor will also submit all Warranties electronically (in PDF format) at the completion of the Project.

1.03 PREPARATION:

- A. Contractor shall obtain warranties, executed in duplicate by each applicable and/or responsible subcontractor(s), supplier(s), and manufacturer(s), within ten (10) days after completion of the applicable item or work. Except for items put into use with District's permission, Contractor shall leave date of beginning of time of warranty blank until the date of completion is determined.
- B. Contractor shall verify that documents are in proper form, contain full information, and are notarized, when required.

- C. Contractor shall co-execute submittals when required.
- D. Contractor shall retain warranties until time specified for submittal.

1.04 TIME OF SUBMITTALS:

- A. For equipment or component parts of equipment put into service during construction with District's permission, Contractor shall submit a draft warranty for that equipment or component within ten (10) days after acceptance of that equipment or component.
- B. Contractor shall submit for District approval all warranties and related documents within ten (10) days after date of completion. Contractor must revise the warranties as required by the District prior to District's approval of Contractor's final Application for Payment.
- C. For items of work delayed beyond date of completion, Contractor shall provide an updated submittal within ten (10) days after acceptance, listing the date of acceptance as start of warranty period.

PART 2 - PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

END OF DOCUMENT

DOCUMENT 01 78 39

RECORD DOCUMENTS**PART 1 - GENERAL****1.01 RELATED DOCUMENTS AND PROVISIONS:**

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions including, without limitation, Documents on Work;
- B. Special Conditions.
- C. Summary of Work.

PART 2 - RECORD DRAWINGS**2.01 GENERAL:**

- A. Contractor shall maintain on Site one set of the following record documents; Contractor shall record actual revisions to the Work:
 - (1) Contract Drawings.
 - (2) Specifications.
 - (3) Addenda.
 - (4) Change Orders and other modifications to the Contract.
 - (5) Reviewed shop drawings, product data, and samples.
 - (6) Field test records.
 - (7) Inspection certificates.
 - (8) Manufacturer's certificates.
- B. As indicated in the Contract Documents, the District will provide Contractor with one set of reproducible, full size original Contract Drawings (mylars).
- C. Contractor shall maintain at each Project Site one set of marked-up plans and shall transfer all changes and information to those marked-up plans, as often as required to keep information concurrent with construction progress, but in no case less than once each month. Contractor shall submit to the Project Inspector one set of reproducible vellums of the Project Record Drawings ("As-Builts") showing all changes incorporated into the Work since the preceding monthly submittal. The As-Builts shall be available at the Project

Site. The Contractor shall submit reproducible vellums at the conclusion of the Project following review of the blue line prints.

- D. Label and date each Record Drawing "RECORD DOCUMENT" in legibly printed letters.
- E. All deviations in construction including, but not limited to, pipe and conduit locations and deviations caused by without limitation Change Orders, Construction Claim Directives, RFIs, and Addenda, shall be accurately and legibly recorded by Contractor.
- F. Locations and changes shall be done by Contractor in a neat and legible manner and, where applicable, indicated by drawing a "cloud" around the changed or additional information.
- G. Contractor shall store Record Documents separate from documents used for construction. Provide files, racks, and secure storage for Record Documents and samples.

2.02 RECORD DRAWING INFORMATION:

- A. Contractor shall record the following information:
 - (1) Locations of Work buried under or outside each building, including, without limitation, all utilities, plumbing and electrical lines, and conduits.
 - (2) Actual numbering of each electrical circuit to match panel schedule.
 - (3) Locations of significant Work concealed inside each building whose general locations are changed from those shown on the Contract Drawings.
 - (4) Locations of all items, not necessarily concealed, which vary from the Contract Documents.
 - (5) Installed location of all cathodic protection anodes.
 - (6) Deviations from the sizes, locations, and other features of installations shown in the Contract Documents.
 - (7) Locations of underground work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stubouts, invert elevations, etc.
 - (8) Sufficient information to locate Work concealed in each building with reasonable ease and accuracy.

In some instances, this information may be recorded by dimension. In other instances, it may be recorded in relation to the spaces in the building near which it was installed.

- B. Contractor shall provide additional drawings as necessary for clarification.
- C. Contractor shall provide reproducible record drawings, made from final Shop Drawings marked "No Exceptions Taken" or "Approved as Noted."
- D. After review and approval of the marked-up specifications by the Project Inspector, Contractor shall provide electronic copies of the drawings (in PDF format) with one file with all of the sheets and one set of individual sheet files at the conclusion of the Project.

PART 3 - RECORD SPECIFICATIONS

3.01 GENERAL:

- A. Contractor shall mark each section legibly to record:
 - (1) Manufacturer, trade name, model / catalog number, and supplier of each Product and item of equipment actually installed.
 - (2) Product substitutions or alternates utilized.
 - (3) Changes made by Addenda and Change Orders and written directives.
- B. After review and approval of the marked-up specifications by the Project Inspector, Contractor shall provide one electronic copy of the specifications (in PDF format) at the conclusion of the Project.

PART 4 - MAINTENANCE OF RECORD DOCUMENTS

4.01 GENERAL

- A. Contractor shall store Record Documents apart from documents used for construction as follows:
 - (1) Provide files and racks for storage of Record Documents.
 - (2) Maintain Record Documents in a clean, dry, legible condition and in good order.
- B. Contractor shall not use Record Documents for construction purposes.

PART 5 – PRODUCTS Not Used.

END OF DOCUMENT

SECTION 01 8114
SUSTAINABLE DESIGN REQUIREMENTS - CAL-GREEN

PART 1 GENERAL**1.01 SUMMARY**

- A. This section includes general requirements and procedures for achieving the most environmentally conscious Work possible within the limits of the construction schedule, contract sum, and available materials, equipment, and products for compliance with the 2019 California Green Building Standards Code (Effective January 1, 2020) and requirements of local Authorities Having Jurisdiction.
 - 1. The more stringent requirement shall apply.
- B. The General Contractor and subcontractors have an essential role; general requirements and procedures are the responsibility of the General Contractor to implement and document. Full cooperation of the General Contractor and subcontractors is essential to addressing the checklist items for application and review.
- C. Chapter 4 Residential Mandatory Measures needed to comply with CAL-Green minimum standards are dependent on material selections. Compliance with mandatory measures should be used as one underlying criterion to evaluate substitution requests.
- D. Additional mandatory measures (not dependent on material selections) needed to comply with CAL-Green are dependent on the Architect's design and other aspects of the project that are not part of the Work of the Contract.
- E. The General Contractor should be familiar with CAL-Green requirements and provide the necessary information and instruction to all subcontractors. Copies of the following referenced standards and materials should be kept on-site:

1.02 DEFINITIONS

- A. Agrifiber Products: Agrifiber products include wheatboard, strawboard, panel substrates and door cores, not including furniture, fixtures and equipment (FF&E) not considered base building elements.
- B. Building Commissioning: A systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements.
- C. Composite Wood Products: A systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements.
- D. MERV: Filter minimum efficiency reporting value, based on ASHRAE 52.2-2007.
- E. Product-Weighted MIR (PWMIR): The sum of all weighted-MIR for all ingredients in a product subject to this article. The PWMIR is the total product reactivity expressed to hundredths of a gram of ozone formed per gram of product (excluding container and packaging).
- F. Reactive Organic Compound: Any compound that has the potential, once emitted, to contribute to ozone formation in the troposphere.
- G. VOC: A volatile organic compound (VOC) broadly defined as a chemical compound based on carbon chains or rings with vapor pressures greater than 0.1 millimeters of mercury at room

temperature. These compounds typically contain hydrogen and may contain oxygen, nitrogen and other elements. See CCR Title 17, Section 94508(a).

1. Where specific regulations are cited from different agencies such as Bay Area Air Quality Management District (BAAQMD), California Air Resources Board (ARB or CARB), etc., the VOC definition included in that specific regulation is the one that prevails for the specific measure in question.

1.03 REFERENCES

- A. American National Standards Institute (ANSI); 1899 L Street, NW, 11th Floor, Washington, DC 20036. Tel: (202)293-8020. Fax: (202)293-9287. <http://ansi.org>.
 1. NSF/ANSI 140.
- B. ASHRAE; 1791 Tullie Circle, N.E., Atlanta, GA 30329. Tel: (404)636-8400. Fax: (404)321-5478. www.ashrae.org.
 1. ASHRAE 52.1-1999.
 2. ASHRAE 52.1-1992.
- C. American Society for Testing and Materials (ASTM); 100 Bar Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. Tel: (877)909-2786. www.astm.org.
 1. ASTM Standard E 1918.
 2. ASTM Standard C 1549.
- D. California Air Resources Board (CARB); 1001 I Street, Sacramento, CA 95814. Tel: (800)242-4450. Fax: (916)445-5025. www.arb.ca.gov.
 1. Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.).
- E. California Code of Regulations (CCR), Office of Administrative Law; 300 Capitol Mall, Suite 1250, Sacramento, CA 95814. Tel: (916)323-6225. Fax: (916)323-6826. www.oal.ca.gov/ccr.htm.
- F. California Building Standards Commission (CBSC); 2525 Natomas Park Drive, Suite 130, Sacramento, CA 95833. Tel: (916)263-0916. Fax: (916)263-0569. www.bsc.ca.gov.
 1. California Building Standards Code (Title 24, California Code of Regulations), 2019 Triennial Edition (current code).
 - a. Part 2 – California Building Code.
 - b. Part 3 – California Electrical Code.
 - c. Part 4 – California Energy Code.
 - d. Part 5 – California Plumbing Code.
 - e. Part 11 – California Green Building Standards Code.
- G. California Department of Public Health (CDPH). Tel: (916)558-1784. www.cdph.ca.gov.
 1. CDPH Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (CDPH Standard Method V1.1 or specification 01350).
- H. The Carpet and Rug Institute (CRI); 100 South Hamilton Street, Dalton, GA 30720. Tel: (706)278-3176. Fax: (706)278-8835. www.carpet-rug.org.
 1. CRI Green Label Plus Program.
- I. Bay Area Air Quality Management District (BAAQMD) ; 21865 Copley Drive, Diamond Bar, CA 91765. Tel: (909)396-2000.
 1. BAAQMD Regulation 8, Rule 3 VOC Limits.
- J. WaterSense, U.S. Environmental Protection Agency, Office of Wastewater Management (4204M), 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Tel: (866)987-7367. www.epa.gov/watersense.

1.04 SUBMITTAL PROCEDURES

- A. General: Additional Sustainable Design submittal requirements are included in other sections of the Specifications.
- B. Sustainable Design submittal requirements are in addition to other submittals. If a submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated CAL-Green mandatory and voluntary measures.
- C. CAL-Green Action Plans: Provide preliminary submittals within 30 calendar days of construction start indicating how the following requirements will be met.
 - 1. Stormwater pollution prevention plan (SWPPP) complying with Sections 4.106.2 and 5.106.1 (amended per 99.05.106.1, 99.05.106.1.1, and 99.05.106.1.2).
 - 2. Construction waste management plan complying with Sections 4.408.1 and 5.408.1.1, and Specification Section 01 74 19 Construction Waste Management.
 - 3. Indoor air quality (IAQ) plan during construction complying with Sections 5.504.1.3, 4.504.1, 5.504.3, 5.504.7 (amended per 99.05.504.7), and Specification Section 01 81 19 Indoor Air Quality Requirements.
 - 4. CAL-Green Report Schedule – Provide schedule for submitting progress reports for stormwater pollution prevention, construction waste management, and indoor air quality during construction.
- D. CAL-Green Reports: Reports shall be submitted to the Architect and Sustainability Consultant at no more than 90-day intervals.
 - 1. Stormwater pollution prevention plan (SWPPP) inspection demonstrating compliance with Sections 4.106.2 and 5.106.1 (amended per 99.05.106.1, 99.05.106.1.1), and 99.05.106.1.2). Include date-stamped photos over the course of site work activities to document the prevention of pollution of stormwater runoff from construction activities through local ordinance or best management practices.
 - 2. Construction waste reduction progress reports demonstrating compliance with Sections 4.408.1, 5.408.1.1 through 5.408.1.3, and Specification Section 01 74 19 Construction Waste Management. Recycle and/or salvage for reuse a minimum 75 percent of nonhazardous construction and demolition waste.
 - 3. Excavated soil and land clearing debris reports demonstrating compliance with Section 5.408.3 and Specification Section 01 7419 Construction Waste Management. 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled.
 - 4. Indoor air quality (IAQ) during construction progress reports demonstrating compliance with Sections 5.504.1.3, 4.504.1, 5.504.3, 5.504.7 (amended per 99.05.504.7), and Specification Section 01 5719 - Temporary Environmental Controls.
 - a. The permanent HVAC system shall only be used during construction if necessary to condition the building within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.1-1992. Replace all filters immediately prior to occupancy.
 - b. At the time of rough installation and during storage on the construction site until final startup of heating, cooling, and ventilating equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal or other methods acceptable to the enforcing agency to reduce the amount of dust, water and debris which may enter the system.
 - c. Where outdoor areas are provided for smoking, prohibit smoking within 25 feet of building entries, outdoor air intakes and operable windows within the building as already prohibited by other laws or regulations.
 - 5. Summary of product data collected for all low-emitting materials, adhesives and sealants complying with Sections 4.504.2.1 and 5.504.4.1, paints and coatings complying with

Sections 4.504.2.2 and 5.504.4.3, aerosol paints and coatings complying with Sections 4.504.2.3 and 5.504.4.3.1, carpet systems complying with Sections 4.504.3 and 5.504.4.4, resilient flooring systems complying with Sections 4.504.4 and 5.504.4.6, and composite wood products complying with Sections 4.504.5 and 5.504.4.5.

E. CAL-Green Documentation and Verification

1. Mandatory measure, Sections 4.106.2 and 5.106.1 (amended per 99.05.106.1, 99.05.106.1.1) Stormwater pollution prevention plan.
 - a. Storm Water Pollution Prevention Plan (SWPPP).
 - b. Construction Documentation: Date-stamped photos, which show implemented measures and any corrective action that was taken.
2. Mandatory measure, Sections 4.408.1 and 5.408.1 Construction waste management.
 - a. Identify construction waste materials to be diverted from disposal.
 - b. Determine if construction waste materials will be sorted on-site (source-separated) or bulk mixed (single stream).
 - c. Identify diversion facilities where collected construction waste material will be taken.
 - d. Specify that the amount of construction waste materials diverted shall be calculated by weight or volume, but not by both.
3. Mandatory measure, Section 5.408.3 Excavated soil and land clearing debris.
 - a. Identify excavated soil and land clearing debris to be diverted from disposal by reuse or recycling.
 - b. Determine if excavated soil and land clearing debris will be sorted on-site.
 - c. Identify reuse or recycling facilities where collected excavated soil and land clearing debris will be taken.
4. Mandatory measure, Sections 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - a. The VOC Content Verification Checklist, LADBS Form GRN 2, shall be completed and verified prior to final inspection approval.
 - b. The manufacturer's specifications showing VOC content for all applicable products shall be readily available at the jobsite and be provided to the field inspector for verification.
5. Mandatory measure, Sections 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - a. The VOC Content Verification Checklist, LADBS Form GRN 2, shall be completed and verified prior to final inspection approval.
 - b. The manufacturer's specification showing VOC content for all applicable products shall be readily available at the jobsite and be provided to the field inspector for verification.
6. Mandatory measure, Sections 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - a. The VOC Content Verification Checklist, LADBS Form GRN 2, shall be completed and verified prior to final inspection approval.
 - b. The manufacturer's specification showing VOC content for all applicable products shall be readily available at the jobsite and be provided to the field inspector for verification.
7. Mandatory measure, Sections 4.504.4 and 5.504.4.6 Resilient flooring systems.
 - a. The manufacturer's specification showing pollution emissions for all applicable products shall be readily available at the jobsite and be provided to the field inspector for verification.
8. Mandatory measure, Sections 4.504.5 and 5.504.4.5 Composite wood products.
 - a. The formaldehyde Emissions Verification Checklist, LADBS Form GRN 3, shall be completed and verified prior to final inspection approval.
 - b. The manufacturer's specification showing formaldehyde content for all applicable products shall be readily available at the jobsite and be provided to the field inspector for verification.
 - c. Chain of custody certificates.
 - d. Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq).
 - e. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards.

- f. Other methods acceptable to the enforcing agency.

1.05 QUALITY ASSURANCE

- A. Sustainable Design Requirements Conference: Conduct conference at the Project site. Review methods and procedures related to sustainable design requirements.

PART 2 PRODUCTS

2.01 SITE MATERIALS

- A. Mandatory measure, Sections 4.106.7 and 5.106.11 (amended per 99.04.106.7 and 99.05.106.11) Hardscape alternatives. If using light colored material as a strategy to reduce nonroof heat islands for 25% of site hardscape:
 1. Use light colored materials with an initial solar reflectance value of at least .30 as determined in accordance with the American Society for Testing and Materials (ASTM) Standards E 1918 or C 1549; or
 2. Use an open-grid pavement system or pervious or permeable pavement system.

2.02 INDOOR PLUMBING FIXTURES

- A. Mandatory measure, Sections 5.303.2 Water reduction, 4.303.1 (amended per 99.04.303.1.2) and 5.303.3 (amended per 05.303.3.2) Water conserving plumbing fixtures and fittings, 4.303.1.3.2 and 5.303.3.3.2 Multiple showerheads serving one shower, and 5.303.4 (amended per 99.05.303.4) Wastewater reduction.

1. Plumbing fixtures shall meet the maximum flow rate values shown in Table 5.303.2.3.
2. Table 5.303.2.3 **WATER REDUCTION FIXTURE FLOW RATES**

a. FIXTURE TYPE	MAXIMUM FLOW RATE
1) Kitchen faucets	1.8 gpm @ 60 psi
2) Wash fountains	1.8 rim space (in.)/20 gpm @ 60 psi
3) Metering faucets	0.20 gallons/cycle
4) Metering faucets for wash fountains	0.20 rim space (in.)/20 gpm @ 60 psi

3. Water closets: The effective flush volume of all water closets shall not exceed 1.28 gallons per flush. Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets.
4. Urinals: The effective flush volume of urinals shall not exceed 0.125 gallons per flush.
5. Single showerheads: Showerheads shall have a maximum flow rate of not more than 2.0 gallons per minute at 80 psi. Showerheads shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Showerheads.
6. Multiple showerheads serving one shower: When a shower is served by more than one showerhead, the combined flow rate of all showerheads and/or other shower outlets controlled by a single valve shall not exceed 2.0 gallons per minute at 80 psi, or the shower shall be designed to allow only one shower outlet to be in operation at a time.
7. Residential lavatory faucets: The maximum flow rate of residential lavatory faucets shall not exceed 1.5 gallons per minute at 60 psi. The minimum flow rate of residential lavatory faucets shall not be less than 0.8 gallons per minute at 20 psi.
8. Lavatory faucets in common and public use areas: The maximum flow rate of lavatory faucets installed in common and public use areas (outside of dwellings or sleeping units) in residential buildings shall not exceed 0.5 gallons per minute at 60 psi.
9. Metering faucets: Metering faucets when installed in residential buildings shall not deliver more than 0.25 gallons per cycle.
10. Kitchen faucets: The maximum flow rate of kitchen faucets shall not exceed 1.8 gallons per minute at 60 psi. Kitchen faucets may temporarily increase the flow above maximum flow rate, but not to exceed 2.2 gallons per minute at 60 psi, and must default to a maximum flow rate of 1.8 gallons per minute at 60 psi.

2.03 FINISH MATERIAL POLLUTANT CONTROL

- A. Mandatory measure, Sections 4.504.2.1 and 5.504.4.1 Adhesives and sealants: Adhesives, sealants, and caulks used on the Project shall meet the requirements of the following standards:
1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable or SCAQMD Rule 1168 VOC limits, as shown in Tables 4.504.1, 4.504.2, 5.504.4.1 and 5.504.4.2. Such products also shall comply with Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products as specified in subsection 2, below.
- B. Tables 4.504.1 and 5.504.4.1 **ADHESIVE VOC LIMIT**
1. (Less Water and Less Exempt Compounds in Grams Per Liter)
 2. Architectural Applications Current VOC Limit

a. Indoor carpet adhesives	50
b. Carpet pad adhesives	50
c. Outdoor carpet adhesives	150
d. Wood flooring adhesives	100
e. Rubber floor adhesives	60
f. Subfloor adhesives	50
g. Ceramic tile adhesives	65
h. VCT and asphalt tile adhesives	50
i. Drywall and panel adhesives	50
j. Cove base adhesives	50
k. Multipurpose construction adhesives	70
l. Structural glazing adhesives	100
m. Single-ply roof membrane adhesives	250
n. Other adhesives not specifically listed	50
 3. Specialty Applications

a. PVC welding	510
b. CPVC welding	490
c. ABS welding	325
d. Plastic cement welding	250
e. Adhesive primer for plastic	550
f. Contact adhesive	80
g. Special purpose contact adhesive	250
h. Structural wood membrane adhesive	140
i. Top and trim adhesive	250
 4. Substrate Specific Applications

a. Metal to metal	30
b. Plastic foams	50
c. Porous material (except wood)	50
d. Wood	30
e. Fiberglass	80
- C. Tables 4.504.2 and 5.504.4.2 **SEALANT VOC LIMIT**
1. (Less Water and Less Exempt Compounds in Grams Per Liter)
 2. Sealants Current VOC Limit

a. Architectural	250
b. Marine deck	760
c. Nonmembrane roof	300
d. Roadway	250
e. Single-ply roof membrane	450
f. Other	420

- 3. Sealant Primers
 - a. Architectural
 - 1) Nonporous 250
 - 2) Porous 775
 - b. Modified bituminous 500
 - c. Marine deck 760
 - d. Other 750
- 4. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds (in units of product, less packaging, which do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of California Code of Regulations, Title 17, commencing with Section 94507.

D. Mandatory measure, Sections 4.504.2.2 and 5.504.4.3 Paints and coatings: Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Tables 4.504.3 and 5.504.4.3, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Tables 4.504.3 and 5.504.4.3, shall be determined by classifying the coating as a Flat, Nonflat or Nonflat-High Gloss coating, based on its gloss, as defined in Subsections 4.21, 4.36 and 4.37 of the 2007 California Air Resources Board, Suggested Control Measure, and the corresponding Flat, Nonflat, or Nonflat-High Gloss VOC limit in Tables 4.504.3 and 5.504.4.3 shall apply.

E. Tables 4.504.3 and 5.504.4.3 **VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS**

1. (Grams of VOC Per Liter of Coating, Less Water and Less Exempt Compounds)

2. Coating Category	Current Limit
a. Flat coatings	50
b. Nonflat coatings	100
c. Nonflat high gloss coatings	150
3. Specialty Coatings	
a. Aluminum roof coatings	400
b. Basement specialty coatings	400
c. Bituminous roof coatings	50
d. Bituminous roof primers	350
e. Bond breakers	350
f. Concrete curing compounds	350
g. Concrete/masonry sealers	100
h. Driveway sealers	50
i. Dry fog coatings	150
j. Faux finishing coatings	350
k. Fire resistive coatings	350
l. Floor coatings	100
m. Form-release compounds	250
n. Graphic arts coatings (sign paints)	500
o. High-temperature coatings	420
p. Industrial maintenance coatings	250
q. Low solids coatings	120
r. Magnesite cement coatings	450
s. Mastic texture coatings	100
t. Metallic pigmented coatings	500
u. Multicolor coatings	250
v. Pretreatment wash primers	420
w. Primers, sealers and undercoaters	100
x. Reactive penetrating sealers	350
y. Recycled coatings	250
z. Roof coatings	50

- | | | |
|-----|---|-----|
| aa. | Rust preventative coatings | 250 |
| ab. | Shellacs | |
| | 1) Clear | 730 |
| | 2) Opaque | 550 |
| ac. | Specialty primers, sealers and undercoaters | 350 |
| ad. | Stains | 250 |
| ae. | Stone consolidates | 450 |
| af. | Swimming pool coatings | 340 |
| ag. | Traffic marking coatings | 100 |
| ah. | Tub and tile refinishing coatings | 420 |
| ai. | Waterproofing membranes | 250 |
| aj. | Wood coatings | 275 |
| ak. | Wood preservatives | 350 |
| al. | Zinc-rich primers | 340 |
- F. Mandatory measure, Sections 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings: Aerosol paints and coatings shall meet PWMIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Sections 94522(c)(2) and (d)(2) of California Code of Regulations, Title 17, commencing with Section 94520.
- G. Mandatory measure, Sections 4.504.4 and 5.504.4.6 Resilient flooring systems: 80% of the total area receiving resilient flooring shall comply with one or more of the following:
1. VOC emission limits defined in CHPS High Performance Products Database.
 2. Products compliance with the CHPS criteria certified under the Greenguard Children & Schools program.
 3. Certification under the Resilient Floor Covering Institute (RCFI) FloorScore program.
 4. Meet the California Department of Public Health's Specification 01350.
 5. Verification of compliance - Documentation shall be provided verifying that resilient flooring materials meet the pollutant emissions limits.
- H. Mandatory measure, Sections 4.504.5 and 5.504.4.5 Composite wood products: New hardwood plywood, particle board, and medium density fiberboard composite wood products used in the interior or exterior of the building shall meet the formaldehyde limits listed in Tables 4.504.5 and 5.504.4.5.
- I. Tables 4.504.5 5.504.4.5 **FORMALDEHYDE LIMITS**
- | | | |
|----|---|---------------|
| 1. | (Maximum Formaldehyde Emissions in Parts per Million) | |
| 2. | Product | Current Limit |
| 3. | Hardwood plywood veneer core | 0.05 |
| 4. | Hardwood plywood composite core | 0.05 |
| 5. | Particle board | 0.09 |
| 6. | Medium density fiberboard | 0.11 |
| 7. | Thin medium density fiberboard | 0.13 |
- J. Mandatory measure, Section 5.504.3 Filters: An air filter with a Minimum Efficiency Reporting Value (MERV) of 8 or higher shall be installed in the mechanical system for outside and return air prior to occupancy.
1. Exceptions:
 2. An ASHRAE 10-percent to 15-percent efficiency filter shall be permitted for an HVAC unit meeting the 2019 California Energy Code having 60,000 Btu/h or less capacity per fan coil, if the energy use of the air delivery system is 0.4 w/cfm or less at design air flow.
 3. Existing mechanical equipment.

PART 3 EXECUTION

3.01 CONSTRUCTION WASTE MANAGEMENT

- A. Mandatory measure, Sections 4.408.1 and 5.408.1 Construction waste management, comply with Specification Section 01 74 19 Construction Waste Management.

3.02 COMMISSIONING

- A. Mandatory measure, Sections 5.410.2 (amended per 99.05.410.2.5.1) Commissioning, comply with Specification Section 01 91 13 General Commissioning Requirements.

3.03 INDOOR AIR QUALITY (IAQ) DURING CONSTRUCTION

- A. Mandatory measures, Sections 5.504.1.3, 4.504.1, 5.504.3, 5.504.7 (amended per 99.05.504.7), comply with Specification Section 01 81 19 Indoor Air Quality Requirements.

END OF SECTION

**SECTION 01 9113
GENERAL COMMISSIONING REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this Section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup; Startup Reports and Prefunctional Checklists executed by Contractor are utilized to achieve this requirement.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents; Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this requirement.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete; Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this requirement.
 - 4. Verify that the Owner's operating personnel are adequately trained; Formal training conducted by Contractor is utilized to achieve this requirement.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. The Commissioning Authority directs and coordinates all commissioning activities; this Section describes some but not all of the Commissioning Authority's responsibilities.
- D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
 - 1. Building envelope:
 - a. Air tightness.
 - 2. Fire Protection Systems.
 - 3. Plumbing Systems:
 - a. Water heaters.
 - b. Booster pumps.
 - c. Landscape irrigation.
 - 4. HVAC System, including:
 - a. Major and minor equipment items.
 - b. Piping systems and equipment.
 - c. Ductwork and accessories.
 - d. Terminal units.
 - e. Control system.
 - f. Sound control devices.
 - g. Vibration control devices.
 - h. Variable frequency drives.
 - 5. Electrical Systems:
 - a. Power quality.
 - b. Emergency power systems.
 - c. Uninterruptible power systems.
 - d. Lighting controls other than manual switches.
 - 6. Electronic Safety and Security:
 - a. Security system, including doors and hardware.

- b. Fire and smoke alarms.
- 7. Communications:
 - a. Voice and data systems.
 - b. Public address/paging.
- B. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 SUBMITTALS

- A. SUBmittals:
 - 1. Make all submittals specified in this Section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
- B. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- C. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.
 - 2. Manufacturer's installation instructions.
 - 3. Startup, operating, and troubleshooting procedures.
 - 4. Fan and pump curves.
 - 5. Factory test reports.
 - 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- D. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- E. Startup Plans and Reports.
- F. Completed Prefunctional Checklists.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will not become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F (0.3 degree C) and resolution of plus/minus 0.1 degree F (0.05 degree C).
 - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 - 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

- A. Commissioning Authority has prepared the Commissioning Plan.
 - 1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 - 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Commissioning Schedule:
 - 1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 - 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 - 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
 - 1. No sampling of identical or near-identical items is allowed.
 - 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 - 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.
 - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for

- equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
- f. Sensor and actuator calibration information.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 4. If any Checklist line item is not relevant, record reasons on the form.
 5. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 6. Submit completed Checklists to Commissioning Authority within two days of completion.
 7. See Section 01 7000 - Execution and Closeout Requirements for additional general startup requirements.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.
 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.

1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:

1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 of this Section for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.

3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. Set pump/fan to normal operating mode.
 2. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 3. Command valve/damper to open; verify position is full open and adjust output signal as required.
 4. Command valve/damper to a few intermediate positions.
 5. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
 - 1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 - 2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 - 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 - 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 - 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 - 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 - 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 - 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
 - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 - 2. Other points will be monitored by the Commissioning Authority using dataloggers.

3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
5. Graphical output is desirable and is required for all output if the system can produce it.
6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 7800 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 02 4100

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Abandonment and removal of existing utilities and utility structures.

1.02 DEFINITIONS

- A. Demolish (Demo): Dismantle a defined component of existing construction, remove it from the Site, and dispose of it either as specified or in lawful manner.
- B. Dispose: Remove from the Project Site in lawful manner.
- C. Reinstall: Install a removed component of existing construction into new construction as indicated.
- D. Remove: Dismantle a defined component of existing construction in a manner which protects and preserves the component for future use/installation; definition includes lawful disposal, unless otherwise specifically indicated to be reinstalled, salvaged, or other described action.
- E. Salvage: Remove in a manner preserving the existing condition and integrity of the component, set aside, store and protect for future reinstallation.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
- B. Coordination: Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Site Plan: Showing:
 - a. Vegetation to be protected.
 - b. Areas for temporary construction and field offices.
 - c. Areas for temporary and permanent placement of removed materials.
 - 2. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
 - 3. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - a. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.

- b. Identify demolition firm and submit qualifications.
- c. Include a summary of safety procedures.
- 4. Schedule of Selective Demolition Activities: Indicate the following:
 - a. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - b. Interruption of utility services. Indicate how long utility services will be interrupted.
 - c. Coordination for shutoff, capping, and continuation of utility services.
 - d. Use of elevator and stairs.
 - e. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

B. Informational Submittals:

- 1. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- 2. Predemolition Photographs or Video: Submit before Work begins.
- 3. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- 4. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.
- 5. Inventory: Submit a list of items that have been removed and salvaged.
- 6. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- 7. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of five years of documented experience.

1.07 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.02 MATERIALS

- A. Fill Material: As specified in Division 31 - Earthwork..

PART 3 EXECUTION

3.01 SCOPE

- A. Remove paving and curbs as required to accomplish new work.
- B. Remove all paving and curbs within site boundaries.
- C. Remove manholes and manhole covers, curb inlets and catch basins as indicated on Drawings.
- D. Remove other items indicated, for salvage, relocation, and recycling.
- E. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.03 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 7000 - Execution and Closeout Requirements.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.

7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- C. Do not begin removal until receipt of notification to proceed from Owner.
 - D. Do not begin removal until built elements to be salvaged or relocated have been removed.
 - E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
 - F. Protect existing structures and other elements that are not to be removed.
 1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
 - G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
 - H. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
 - I. Perform demolition in a manner that maximizes salvage and recycling of materials.
 1. Comply with requirements of Section 01 7419.
 2. Dismantle existing construction and separate materials.
 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.04 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.
- I. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.05 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Section 01 5000 - Temporary Facilities and Controls.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 5000 - Temporary Facilities and Controls.

3.06 DEBRIS AND WASTE REMOVAL

- A. Remove debris and trash from site.
- B. Do not allow demolished materials to accumulate on-site.
- C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- D. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- E. Remove from site all materials not to be reused on site; comply with requirements specified in Section 01 5013.
- F. Leave site in clean condition, ready for subsequent work.
- G. Clean up spillage and wind-blown debris from public and private lands.

3.07 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

**SECTION 02 4413
TREE REMOVAL AND SALVAGE**

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes the following:
 - 1. Tree removal, salvage, milling and disposal of the existing Sequoia sempervirens (Coast Redwood).
 - 2. Move chipped material to the back of the school for use in the planting areas.

1.02 RELATED WORK

- A. Section 06 2013 – Exterior Finish Carpentry

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Identification of trees to be removed.
 - 2. Traffic closure and management.
 - 3. Time/schedule.
 - 4. Removal, salvage, milling and disposal.

1.04 QUALITY ASSURANCE

- A. Arborists: International Society of Arboriculture (ISA) certified.

1.05 SUBMITTALS

- A. Submit photo documentation and list of salvaged wood.
- B. Submit milling facility certification.
- C. Submit kiln drying results showing moisture content of milled wood.

PART 2 PRODUCTS

2.01 SALVAGED WOOD MILLING

- A. Mill salvaged wood in an industrial wood milling facility.
 - 1. Approved facility: Green Waste Recycle Yard, 510-527-8733, or equal.
- B. Rip, surface, and trim salvaged wood to finish profiles specified in other sections and as shown on Drawings.
- C. Kiln dry rough sawn lumber, to a maximum moisture content of 19%.
- D. Stack salvaged, milled wood on site. Stacks shall be level with spacers between each piece for sufficient air flow during acclimation process.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine location and verify tree marked for removal.
- B. Verify area for safe tree felling including establishing “off-limits” areas for unauthorized persons and vehicles.
- C. Identify electrical obstructions and other hazards.

- D. Coordinate tree-felling schedule, public safety and access, vehicular traffic control, and other tree-felling operational requirements with facility management.

3.02 TREE REMOVAL, SALVAGE, AND DISPOSAL

- A. General:
 - 1. Perform tree felling work in accordance with ANSI Z133.1-2006.
 - 2. Set in place safety precautions to protect the operators and the general public and property prior to any tree removal work. Safety may not be compromised.
 - 3. Furnish necessary supervision, labor, vehicles, and equipment capable of efficient and effective tree removal. Maintain on site at all times, a competent individual authorized to represent the Contractor.
 - 4. Proceed with preparatory work and tree cutting only in the presence of facility management representative.
- B. Plan and prepare the area as approved by facility management.
 - 1. Position equipment to accomplish safe, effective, and efficient removal of trees and sections of trees while minimizing impact on improved property.
 - 2. Cordon-off with tape or ropes and clearly mark work areas “off-limits” to unauthorized persons and vehicles.
 - 3. Provide vehicular traffic controls at the work area maintaining safe and continuous traffic flow as directed by facility management, minimizing hazards and inconvenience to public.
 - 4. Use portable warning signs on all work areas. Traffic control devices shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTDC).
- C. Inspection and determination of electrical hazards by a qualified arborist is required before climbing or otherwise entering or performing work on or in a tree.
 - 1. Where electrical hazards exist, perform Work only by qualified line-clearance arborists or qualified line-clearance trainees under the direct supervision of qualified line-clearance arborists.
 - 2. Perform work in proximity to electrical hazards according to the provisions of ANSI Z133.1 Section 4.2, Working in Proximity to Electrical Hazards.
- D. Cut tree as close to the ground as possible. Whenever large tree sections being removed endanger people or property, secure and lower sections with rope safely and in a controlled manner.
- E. Salvage sound tree limbs, branches, and trunks that are at least 5 inches in diameter.
- F. Cut limbs and branches to maximum truck load lengths possible.
- G. Cut tree limbs from trunk as close as possible.
 - 1. Flush cut log - no crotch or splits.
 - 2. Cut-out large holes and rot.
 - 3. Haul wood for milling.
- H. Chip small branches and limbs. Load and haul wood that is not to be salvaged and is too large to be chipped. Dispose of wood chips and wood pieces.
- I. Stump Grinding:
 - 1. Perform stump grinding in accordance with ANSI Z133.1, Section 5.1, General; and Section 5.5, Stump Cutters.
 - 2. Grind stumps using specialized equipment to a minimum depth of 12 inches below existing grade or as needed to remove all exposed root material greater than one inch in diameter.
 - 3. Rake and remove chips and debris generated by stump grinding.
 - 4. Place and compact with topsoil void left by tree stump.
- J. Immediately haul-off brush, limbs, logs, or other debris to avoid accumulation that may pose as a hazard to motorists and pedestrians.
- K. Broom clean sidewalks, curbs, gutters, and pavement areas at completion of work.

END OF SECTION

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SECTION 03 1000
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.03 REFERENCE STANDARDS

- A. California Code of Regulations, Title 24, Part II, 2019 Edition with DSA Amendments, also known as the California Building Code (CBC)
- B. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- C. ACI 301 - Specifications for Structural Concrete; 2016.
- D. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- E. ACI 347R - Guide to Formwork for Concrete; 2014.
- F. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- H. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on void form materials and installation requirements.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
- D. Permanent Insulated Foam Panel Formwork Shop Drawings: Include calculations or selections from manufacturer's prescriptive design tables that indicate compliance with applicable building code and manufacturer's requirements.
 - 1. Include test reports for performance criteria specified.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with California Building Code, with DSA Amendments standards of the State of California.

- B. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in California.
- C. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
- C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls.
- D. Comply with CBC with respect to design, fabrication, erection, and removal of formwork.
- E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.
- F. Use the following form types:
 1. Concrete Walls Not Exposed To View: Site fabricated panel forms or board forms.
 2. Concrete Walls Exposed To View: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.

2.02 WOOD FORM MATERIALS

- A. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I. Minimum 5/8-inch thick exterior grade plywood with sealed edges
- B. Lumber: Douglas Fir Larch species; Standard grade; with grade stamp clearly visible.
- C. Board Form: Shiplap or tongue and groove lined with PS 1 grade Plyform Class I and II Exterior 1/2-inch or HDO Exterior 1/2-inch or 3/16-inch thick fiberboard conforming to FS LLL-B-810a(1), type I.

2.03 REMOVABLE PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches thick.

2.04 PERMANENT PREFABRICATED FOAM PANEL FORMWORK

- A. Expanded Polystyrene (EPS) Insulation Board: ASTM C578, Type VIII.
 - 1. Density: 1.15 lb/cu ft.
 - 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

2.05 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 3/4 inch in concrete surface.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - 1. Composition: Colorless reactive, mineral oil-based, soy-based, or vegetable-oil based compound.
 - 2. Do not use materials containing diesel oil or petroleum-based compounds.
 - 3. Products:
 - a. SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/sle.
 - b. W. R. Meadows, Inc; Duogard: www.wrmeadows.com/sle.
- C. Filler Strips for Chamfered Corners: Rigid plastic type; 1/2 inch size; maximum possible lengths.
- D. Dovetail Anchor Slot: Galvanized steel, at least 22 gage, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- E. Flashing Reglets: Galvanized steel, at least 22 gage, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- G. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.
- B. Excavations are sufficient to permit placement, inspection and removal of forms.
- C. Excavations for earth forms have been neatly and accurately cut.
- D. Conditions are otherwise proper for formwork construction.

3.02 EARTH FORMS

- A. Construct wood edge strips at top sides of excavations
- B. Provide forms for footings wherever concrete cannot be placed against solid earth excavation
- C. Remove loose dirt and debris prior to concrete pours
- D. Foundation concrete may be placed directly into neat excavations provided the foundation trench walls are stable as determined by the Geotechnical Engineer, subject to the approval of DSA. In such case, minimum formwork shown on the drawings is mandatory to ensure clean excavations immediately prior to and during the placing of concrete.

3.03 WALL AND OTHER FORMED ELEMENTS

- A. Erect outside forms for exposed exterior walls first and obtain the Architect's approval before reinforcement is placed. Obtain Architect's approval of the reinforcement before interior form is erected.
- B. Carefully align inside and outside forms before tightening ties.
- C. Plywood Forms: Insure vertical joints are plumb and horizontal joints are level; arrange joints and ties in geometrical pattern as approved by the Architect.
- D. Form inside corners at exposed conditions with mitered boards or plywood so that no concrete is placed against form ends.
- E. After erection, seal all cracks, holes, slits, gaps, and apertures in forms so that they will withstand the pressure and will remain completely watertight.
- F. Provide a means to seal the bottom of forms at construction joints such as foam tape or other gasket devices.
- G. Apply a coating of release agent prior to the erection of formwork. Follow approved manufacturer's recommendations.

3.04 CONSTRUCTION JOINTS

- A. Provide where shown on the drawings as directed by the Architect and per CBC.
- B. Provide key indentations at all joints.
- C. Provide pour strips on inside face of forms at horizontal joints, but remove strips and thoroughly clean out reglets before placing subsequent portions of wall.
- D. Prevent formations of shoulders and ledges.
- E. Provide means for drawing forms into firm contact with concrete before placing additional concrete over previous pours where shrinking and warping has separated concrete from forms.

3.05 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Install permanent insulated foam panel formwork per manufacturer's recommendations.
- D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- E. Align joints and make watertight. Keep form joints to a minimum.
- F. Obtain approval before framing openings in structural members that are not indicated on drawings.
- G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- H. Coordinate this section with other sections of work that require attachment of components to formwork.
- I. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.06 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.07 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.08 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean and protect permanent insulated concrete foam panel formwork per manufacturer's recommendations.
- C. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.09 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.
- B. Construct permanent insulated foam panel formwork to maintain tolerances required by ACI 301.

3.10 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.11 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
 - 1. Vertical surfaces of walls, columns, beams: 60% of f'c and 7 days minimum.
 - 2. Beams and slabs: 75% of f'c and 14 days minimum.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

SECTION 03 1513

WATERSTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Waterstops

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate the installation of waterstops with size, location and installation of underground service utilities.
 2. Coordinate the installation of waterstops with formwork.
 3. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this Section.
 1. Required Attendance: Contractor's quality control supervisor or superintendent, Architect, structural engineer, Owner's independent testing agency, all affected trades including reinforcing subcontractor and concrete supplier, waterproofing manufacturer, and 3rd party inspector.
 2. Discuss construction document requirements, required clarifications to construction documents, construction schedule, coordination of affected trades, construction contraction and isolation joints, joint-filler strips, submittal requirements, approved submittals, and required inspections.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Submit manufacturers' data on all specified manufactured products showing compliance with specified requirements and installation instructions.
 - a. Product data for components and for system.
 - b. Property specifications for waterstop materials.
 2. Shop Drawings: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- B. Informational Submittals:
 1. Installation instructions.
 - a. Recommendations for cleaning and preparing surfaces to receive waterstop.
 2. Include sample of warranty customized for this Project.

1.04 QUALITY ASSURANCE

- A. Perform work of this Section in accordance with ACI 117, ACI 301 and ACI 318 and manufacturer's published literature.
 1. Maintain one copy of each document on site.
- B. Single Source Responsibility: Furnish materials from waterproofing manufacturer.
- C. Installer Qualifications: A qualified installer who employs on Project personnel qualified as acceptable to manufacturer with experience on at least five projects of similar nature in past five years, and who is an Approved Applicator as determined by waterstop manufacturer.
- D. Manufacturer Qualifications: A firm experienced in manufacturing Products specified in this Section with minimum ten years experience.
- E. Testing and Inspection:

1. Completed Systems: Manufacturer's representative and Independent inspector will inspect completed installation and submit installation report summarizing installation and confirm installation is in conformance with manufacturer's installation requirements and the Contract Documents, and will result in a properly functioning system with no leaks.
2. Independent inspection service to verify and approve substrate prior to installation; monitor waterstop material installation compliance with the project contract documents and manufacturer's published literature and site specific details. Independent Inspection Firm shall be an approved company participating with the waterstop manufacturer's Certified Inspection Program. Inspection service shall produce reports and digital photographs documenting each inspection. Reports shall be made available to the Contractor, waterstop installer, waterstop material manufacturer, and Architect. Inspections should include substrate examination, beginning of waterproofing installation, periodic intervals, seam welding and final inspection prior to concrete or backfill placement against the waterproofing.
3. Post-Installation Observation: Inspect membrane following the installation of waterstop and structural reinforcing, but prior to the placement of concrete and other superimposed materials. Repair damage or unacceptable conditions prior to placement of concrete and other superimposed materials.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.06 FIELD CONDITIONS

- A. Environmental Requirements: Comply with more restrictive of following or manufacturer's written requirements under which products can be installed.

1.07 SEQUENCING

- A. Place delivery system as concrete installation proceeds, in accordance with manufacturer's instruction.

1.08 WARRANTY

- A. Special Warranty: Prepare and submit in accordance with Section 017700. Warrant installation as watertight for period of 15 years.

PART 2 PRODUCTS

2.01 BONDING AND JOINTING PRODUCTS

- A. Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete.
 1. Acceptable Products:
 - a. Carlisle Coatings & Waterproofing Inc; MiraSTOP.
 - b. CETCO; Waterstop-RX-101.
 - c. CETCO; Waterstop-RX-102.
 - d. GCP Advanced Technologies Construction Products; Adcor ES.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. Sika Greenstreak; Swellstop.
 - g. Tremco; Superstop.
- B. Primer: Manufacturer's standard primer.
- C. Provide wire ties and fasteners as required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this Section.

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Remove all fins, projections, and other detrimental irregularities on surfaces to receive waterproofing systems; comply with waterproofing system manufacturer's requirements for surface preparation.

3.03 WATERSTOP INSTALLATION

- A. Install in accordance with ACI 117, ACI 301 and ACI 318 and manufacturer's published literature.
- B. Self-Expanding Strip Waterstops:
 - 1. Install same day or within 24 hours of concrete pour.
 - 2. Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
 - 3. Firmly press into place.
 - 4. Set in sealant.
 - 5. Install in longest lengths practicable.
 - 6. Butt end joints together per manufacturer's instructions. Do not overlap, miter cut changes in direction.
 - 7. Support and protect from displacement by concrete placement and subsequent construction.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed waterproofing installation before covering with other construction, and provide written report stating that installation complies with manufacturer's written instructions.
 - 1. Remove and replace applications of bentonite waterproofing where inspection indicates that it does not comply with specified requirements.
- B. Owner will provide inspection services in accordance with Section 01 4000 - Quality Requirements.
 - 1. Require manufacturer's field representative to observe waterstop system installations on a daily basis throughout the installation process when such work is being performed.
 - 2. Comply with instructions provided by manufacturer's field representative for installation of waterproofing systems, whether or not specifically included in manufacturer's printed installation instructions and specifications, to ensure that installations will comply with all system manufacturer's requirements to provide specified warranty, and to ensure that waterproofing systems will perform according to manufacturer's published performance characteristics and specifications.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. California Code of Regulations, Title 24, Part II, 2019 Edition with DSA Amendments, also known as California Building Code (CBC).
- B. ACI 301 - Specifications for Structural Concrete; 2016.
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- D. ACI SP-66 - ACI Detailing Manual; 2004.
- E. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2006 (Reapproved 2011).
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- G. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.
- H. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2017.
- I. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- J. CRSI (DA4) - Manual of Standard Practice; 2009.
- K. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- D. Reports: Submit certified copies of mill test report of reinforcement materials analysis. Where reinforcing is to be welded, mill test reports shall verify the weldability of the steel.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
 - 1. Maintain one copy of each document on project site.

- B. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.
- C. The District's Testing Agency will provide tests in accordance with CBC.
 - 1. Collect mill test reports for reinforcement.
 - 2. Take samples from bundles at fabricators.
 - a. When bundles are identified by heat number and accompanied by mill analysis, two specimens shall be taken from each ten (10) tons, or fraction thereof, of each size and grade.
 - b. When reinforcement is not positively identified by heat numbers or when random sampling is intended, two specimens shall be taken from each 2½ tons, or fraction thereof, of each size and grade.
 - 3. Test for tensile and bending strengths.
 - 4. Provide inspection of welding, including prior fit-up, welding equipment, weld quality and welder certification in accordance with AWS D1.4. Chemical analysis sufficient to determine carbon equivalent and minimum preheat temperature shall be performed when reinforcement does not conform to low-alloy steel requirements of CBC.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Plain billet-steel bars.
 - 2. Unfinished.
- B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
 - 1. Unfinished.
- C. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
 - 1. WWR Style: As indicated on drawings.
- D. Welded Deformed Bar Anchors: ASTM A-104, fy = 70,000, flux filled deformed bar anchors. Same as Nelson D2L.
- E. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 RE-BAR SPLICING

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.
 - 1. Products:
 - a. Threaded coupler: Lenton Standard coupler by ERICO or equal product substituted per Section 01630. Couplers may be Type 1 except where otherwise noted.
 - 1) Type 1 Couplers shall develop 125-percent of specified yield strength reinforcement.
 - 2) Type 2 Couplers shall develop 160-percent of the tensile strength or 200-percent of the yield strength of reinforcement.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

- B. Welding of reinforcement is permitted only with the specific approval of Architect. Perform welding in accordance with AWS D1.4/D1.4M.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
 - 1. Review locations of splices with Architect.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as follows:
 - 1. Walls (exposed to weather or backfill): 2 inch.
 - 2. Footings and Concrete Formed Against Earth: 3 inch.
 - 3. Slabs on Fill: 1 inch.
- E. Conform to CBC code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 40 00, will inspect installed reinforcement for conformance to contract documents before concrete placement.
- B. The District's testing Agency will inspect shop and field welding of reinforcing bars in accordance with CBC

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete building frame members.
- B. Concrete for composite floor construction.
- C. Elevated concrete slabs.
- D. Floors and slabs on grade.
- E. Concrete shear walls, elevator shaft walls, and foundation walls.
- F. Joint devices associated with concrete work.
- G. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 35 11 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- D. Section 07 92 00 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

- A. California Code of Regulations, Title 24, Part II, 2019 Edition with DSA Amendments, also known as California Building Code (CBC).
- B. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- C. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- D. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).
- E. ACI 301 - Specifications for Structural Concrete; 2016.
- F. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- G. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- H. ACI 305R - Guide to Hot Weather Concreting; 2010.
- I. ACI 306R - Cold Weather Concreting; 2010.
- J. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- K. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- L. ACI 347R - Guide to Formwork for Concrete; 2014.
- M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.

- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2016b.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.
- P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- R. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.
- S. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.
- T. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- U. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- V. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- W. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.
- X. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2016.
- Y. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes; 2001 (Reapproved 2012).
- Z. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- AA. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- AB. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.
- AC. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- AD. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- AE. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.
- AF. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2015.
- AG. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2011.
- AH. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011 (Reapproved 2016).
- AI. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- AJ. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

- AK. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.
- AL. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
- AM. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
 - 3. Certified copies of mix designs for each concrete class specified including compressive strength test reports
 - 4. Mix designs shall be sealed and signed by a California Professional Civil Engineer.
- D. Shop Drawings: Show construction, expansion and contraction joint locations. Submit to Architect for review.
- E. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
- F. Verification Samples: Submit sample chips of specified colors indicating pigment numbers and required dosage rates, for subsequent comparison to installed concrete.
- G. Samples: Submit samples of underslab vapor retarder to be used.
- H. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
 - 1. Maintain one copy of each document on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 03 10 00.

2.02 REINFORCEMENT

- A. Comply with requirements of Section 03 20 00.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.

- B. Fine and Coarse Aggregates: ASTM C 33., non-reactive per ASTM C33 Appendix XI and CBC 1903A.5
- C. Lightweight Aggregate: ASTM C330/C330M.
- D. Fly Ash: ASTM C618, Class F.
- E. Calcined Pozzolan: ASTM C618, Class N.
- F. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
- G. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
 - 1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
- H. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.
 - 1. Manufacturers:
 - a. W.R. Grace's "Daravair," Master Builders.
 - b. Master Builders' "Micro-Air,".
 - c. Sika Corp.'s "Sika Aer,"
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
 - 1. Manufacturers:
 - a. Euclid Chemical Company; PLASTOL 6420: www.euclidchemical.com/#sle.
 - b. W.R. Grace's "Daracem 19,"
 - c. Master Builders' "Rheobuild,"
 - d. Sika Corp.'s "Sikament,"
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
 - 1. Manufacturers:
 - a. Euclid Chemical Company; ACCELGUARD 80: www.euclidchemical.com/#sle.
 - b. W.R. Grace's "Polarset,"
 - c. Master Builder's "Pozzutec 20,"
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
 - 1. Manufacturers:
 - a. W.R. Grace's "Daratard-17,".
 - b. Master Builders' "Pozzoliith R,"
 - c. Sika's "Plastiment,"
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Water Reducing Admixture: ASTM C494/C494M Type A.
 - 1. Manufacturers:
 - a. Same as Grace Construction Materials' "WRDA with Hycol"; Master Builders "Pozzolith 322N"; Sika Corp.'s "Plastocrete 161".
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties. For use at Elevator Pit Walls.
 - 1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.

2. Manufacturers:
 - a. Xypex Chemical Corporation; XYPEX Admix C-500: www.xypex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- A. Shrinkage reducing admixture at polished (architecturally exposed) concrete slab on grade:
 1. Manufacturers:
 - a. GCP Applied Technologies "Eclipse Floor"
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. See architectural drawings for extent of polished concrete.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 1. Color: As selected by Architect from manufacturer's full range.

2.05 ACCESSORY MATERIALS

- A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 1. Grout: Comply with ASTM C1107/C1107M.
 2. Height Change, Plastic State; when tested according to ASTM C827/C827M:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.
 3. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
 4. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
 5. Flowable Products:
 - a. Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
 - b. Five Star Products, Inc; Five Star Fluid Grout 100: www.fivestarprouducts.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 6. Low-Slump, Dry Pack Products:
 - a. Five Star Products, Inc; Five Star Grout: www.fivestarprouducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

- A. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
 1. Configuration: As indicated on drawings.
 2. Size: As indicated on drawings.
 3. Manufacturers:
 - a. Concrete Sealants, Inc; Conseal CS-231; Colloid Environmental Technologies Company; Volclay Waterstop-RX; TCMiraDRI: Mirastop..
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 1. Material: ASTM D1751, cellulose fiber.
 2. Manufacturers:
 - a. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.
 1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
 2. Height: To suit slab thickness.

2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.
- C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- E. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated.
 - a. CLASS A (FOUNDATIONS, WALLS) = 4,000 psi
 - b. CLASS B (SLAB ON GRADE, HOUSEKEEPING PADS ON GROUND FLOOR, CURBS) = 4,000 psi
 - 2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
 - 3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
 - 4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
 - 5. Water-Cement Ratio: Maximum 50 percent by weight.
 - 6. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
 - 7. Maximum Slump: 4 inches.
 - 8. Maximum Aggregate Size: 3/4 inch.
 - 9. Maximum dry unit weight: 145 lb per cubic foot.
- F. Structural Lightweight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated.
 - a. CLASS C (FILL ON METAL DECK & HOUSEKEEPING PADS AT ELEVATED FLOORS) = 4,000 psi
 - 2. Water-Cement Ratio: Maximum 50 percent by weight.
 - 3. Total Air Content: 3 percent, determined in accordance with ASTM C173/C173M.
 - 4. Maximum Slump: 4 inches.
 - 5. Maximum Aggregate Size: 3/4 inch.
 - 6. Maximum dry unit weight: 115 lb per cubic foot.

2.08 MIXING

- A. Batch Plant Conditions:
 - 1. Batch plant shall be certified to comply with the requirements of the National Concrete Ready Mix Association.
 - 2. Ensure equipment and plant will afford accurate weighing, minimize segregation and will efficiently handle all materials to satisfaction of the Architect and the District's Testing Agency.
 - 3. Replace at no additional expense equipment the Architect and the District's Testing Agency deem inadequate or unsuitable.
 - 4. Use approved moisture meter capable of determining moisture content of sand.
- B. Transit Mixers: Comply with ASTM C94/C94M.

2.09 SOURCE QUALITY CONTROL

- A. The District's Testing Agency will:
 - 1. Review mix designs, certificates of compliance, and samples of materials the Contractor proposes to use.

2. Test and inspect materials, as necessary, in accordance with ACI 318 and CBC for compliance with requirements.
 3. Take samples as required from the Contractor's designated sources.
 4. Take one grab sample for each 100 tons of Portland cement except that, when used in bulk loading ready-mix plants where separate bins for pretested cement are not available, take grab samples for each shipment of cement placed in bin with not less than one sample being taken for each day's pour and subsequently test such samples if required by the Architect who may be so advised by DSA.
 5. Test both coarse and fine aggregate by use of solution of sodium or magnesium sulfate, or both whenever in the judgment of the Architect such tests are necessary to determine quality of material. Perform such tests in accordance with ASTM C88. Loss shall not exceed 6-percent of either fine or coarse aggregate. Aggregate failing to comply with this requirement may be used in the Work provided it contains less than 2-percent of shale and other deleterious particles and shows a loss in soundness test of not more than 10-percent when tested in the sodium sulphate solution. Test aggregates as required by CBC.
 6. Test for sand equivalent of fine aggregate in accordance with California Test 217.
 7. Test for cleanness value of coarse aggregate in accordance with California Test 227.
 8. Inspect plant prior to any work to verify following:
 - a. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.
 - b. Other plant quality controls are adequate.
 9. Continuously inspect quality and quantity of materials used in transit mixed concrete, in batched aggregates and ready-mixed concrete at mixing plant or other location where other materials are measured.
- B. Waiver of Batch Plant Inspection
1. Continuous batch plant inspection may be waived if the plant complies with ASTM C94 and has been certified by an agency acceptable to DSA to comply with the requirements of the National Ready Mix Concrete Association.
 2. When continuous batch plant inspection is waived, the following requirements shall apply:
 - a. Testing Agency shall check the first batching at the start of work and furnish mix proportions to the licensed Weighmaster.
 - b. Licensed Weighmaster shall identify material quantities and certify each load by a ticket.
 - c. Project Inspector shall collect truck mix tickets with load identification and maintain a daily record of placement. Trucks without a load ticket identifying the mix shall be rejected. Copies of daily placement record shall be submitted to DSA.
 - d. At the end of the project, the Weighmaster shall submit an affidavit to DSA certifying that all concrete supplied conforms to proportions established by mix designs.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on the drawings. Do not use sand.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

- A. Locate joints as indicated on the drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.05 SEPARATE FLOOR TOPPINGS

- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
- B. Place required dividers, edge strips, reinforcing, and other items to be cast in.
- C. Apply bonding agent to substrate in accordance with manufacturer's instructions.
- D. Place concrete floor toppings to required lines and levels.
 1. Place topping in checkerboard panels not to exceed 20 feet in either direction.
- E. Screed toppings level, maintaining surface flatness of maximum 1:1000.

3.06 FIELD QUALITY CONTROL

- A. The District's Testing Agency will perform field quality control tests as specified below:
 1. Review concrete mix designs.
 2. Inspect concrete and grout placement continuously.
 3. Test concrete to control slumps according to ASTM C143.
 4. Continuously monitor concrete temperature as it arrives on the site.

- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 50 cubic yards or 2,000 square feet of surface areas of slab and walls poured daily or less of each class of concrete placed.
 - 1. Retain one cylinder for 7-day test, two for the 28-day test and hold one cylinder for additional testing as required.
 - 2. Number each cylinder and date each set; and keep accurate record of pour each set represents.
 - 3. Transport specimen cylinders from job to laboratory after cylinders have cured for 24-hours on site. Cylinders shall be covered and kept at air temperatures between 60 and 80 degrees Fahrenheit.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.07 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.08 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Protect exposed corners of concrete from traffic or use which will damage them in any way.
- C. Make provisions to keep all exposed concrete free from laitance caused by spillage or leaking forms or other contaminants. Do not allow laitance to penetrate, stain, or harden on surfaces which have been textured.

END OF SECTION

**SECTION 03 3500
CONCRETE FINISHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. cast-in-place concrete finishes.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review concrete design mixture and examine procedures for ensuring quality of concrete materials and finishes. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.03 SUBMITTALS

- A. Action Submittals:
1. Product Data: For each type of product.
 2. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- B. Informational Submittals:
1. Material Certificates: For each of the following, signed by manufacturers:
 - a. Curing compounds.
 - b. Floor and slab treatments.
 2. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
 3. Field quality-control reports.
 4. Minutes of preinstallation conference.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
1. 5.504.4.3 Paints and coatings.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

1.06 MOCK-UPS

- A. Mock-ups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 16 sq. ft. for slab-on-grade in the location indicated or, if not indicated, as directed by Architect.
 - a. Provide test panels for the following:
 - 1) Concrete finishes.
2. Mock-ups may not become part of the completed Work unless authorized by Architect.

1.07 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 1. When average high and low temperature is expected to fall below 40 deg F (4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.08 WARRANTY

- A. Manufacturer's Warranty: Warrant vapor emission control treatment against manufacturing defects and improper installation for a period of 15 years. Warranty shall:
 1. Cover costs of treatment materials, cementitious compounds, and labor costs of application and preparation.
 2. Extend warranty to flooring material, adhesive, and installation labor for same period against moisture vapor emission related failure.
 3. Guarantee that concrete curing and water vapor emission control system was installed correctly.

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 1. ACI 301.
 2. ACI 117.

2.02 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: Two layers kraft paper with tri-directional reinforcing fibers embedded in high grade asphalt.
 1. Basis of Design Manufacturer:
 - a. Fortifiber Building Systems Group; Orange Label Sisalkraft.
 - b. Prior approved equal.
- C. Water: Potable.

- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Acceptable Products:
 - a. BASF Corporation-Construction Systems; MasterKure CC 160WB: www.master-builders-solutions.basf.us.
 - b. BASF Corporation-Construction Systems; MasterKure CC 1315 (Pre-2014: Kure 1315).
 - c. ChemMasters, Inc; Safe-Cure & Seal 309.
 - d. Euclid Chemical Company (The); an RPM company.; Super Rez-Seal.
 - e. L&M Construction Chemicals, Inc.; Dress & Seal WB
 - f. W.R. Meadows, Inc; Vocomp30.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C1315, Type I, Class A, nondissipating.
 - 1. Acceptable Products:
 - a. BASF Corporation-Construction Systems; MasterKure CC 160 WB (Pre-2014: Kure-N-Seal WB).
 - b. Dayton Superior; Cure & Seal 1315 EF.
 - c. L&M Construction Chemicals, Inc; Dress & Seal WB.

- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound to Prevent Moisture Vapor Emissions: ASTM C309.
 - 1. Basis of Design Product:
 - a. Floor Seal Technology, Inc.; VaporSeal 309: www.floorseal.com.
 - b. Approved equal.
 - 2. Moisture Vapor Emissions Remedial Coating:
 - a. Performance characteristics:
 - 1) Water vapor transmission per ASTM E96 – 95% reduction.
 - 2) Concrete adhesion per ASTM D7234 – 100% concrete cohesive failure or 540+ psi
 - 3) Alkalinity resistance per ASTM D1308 – Resist pH 14 exposure for 16 days
 - b. Basis of Design Product:
 - 1) Floor Seal Technology, Inc.; MES 100: www.floorseal.com.
 - 2) Approved equal.

2.03 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.17 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 inch (3.17 mm) to 1/4 inch (6.35 mm) or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C109/C109M.

PART 3 EXECUTION

3.01 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view,.

2. Concrete Exposed to View: Finish formed concrete in accordance with ACI 301 - Specifications for Structural Concrete; 2010 Surface Finish 1.0 with surface tolerance to meet ACI 117 Class A.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.02 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6.35 mm) in one direction.

1. Apply scratch finish to surfaces indicated.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated and to receive trowel finish.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view, and to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

E. Finish surfaces to the following tolerances, according to ASTM E1155 (ASTM E 1155M), for a randomly trafficked floor surface:

1. Slab on Grade:

a. Corridor Flooring: Specified overall values of flatness, SOV FF 45; and of levelness, SOV FL 35; with minimum local values of flatness, MLV FF 30; and of levelness, MLV FL 24.

b. Floors: Specified overall values of flatness, SOV FF 35; and of SOV levelness, FL 24; with minimum local values of flatness, MLV FF 25, and of levelness, MLV FL 17.

2. Suspended Slabs

a. Corridor Flooring: Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

b. Specified overall values of flatness, SOV FF 35; and of SOV levelness, FL 20; with minimum local values of flatness, MLV FF 24.

3. Concrete Slabs to be polished in accordance with Section 033543 - Polished Concrete Floor Finishing: Specified overall values of flatness, F(F) 50; and of levelness, F(L) 30; with minimum local values of flatness, F(F) 35; and of levelness, F(L) 20.

a. Steel trowel the surface in three passes in accordance with ACI 302.1R, Class 5 floor to produce a smooth, dense surface free from blemishes including trowel burn, marks and/or visible trowel patterns and within specified tolerances for floor flatness.

F. Broom Finish: Apply a slip-resistant broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.03 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306R for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308R, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12 inch (305 mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (305 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.04 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Defer joint filling until concrete has aged at least 6 months. Do not fill joints until construction traffic has permanently ceased.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- D. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50.8 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.05 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (12.70 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19.05 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
- E. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 inch (19.05 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- F. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- G. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- H. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.06 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

- C. Measure floor and slab flatness and levelness according to ASTM E1155 (ASTM E 1155M) within 24 hours of finishing.

3.07 PROTECTION OF TREATMENTS

- A. Protect floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

**SECTION 03 3541
CONCRETE SEALING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete sealers.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with sealed concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Sealed concrete finishing Subcontractor.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data: For each type of product.
 2. Sealed Concrete Schedule: Submit plan showing sealed concrete surfaces and schedule of sealing operations for each area of sealed concrete before start of sealing operations. Include locations of all joints, including construction joints.
 3. Samples for Initial Selection: For each type of product requiring color selection.
 4. Samples for Verification: For each type of exposed color.
- B. Informational Submittals:
 1. Qualification Data: For Installer.
 2. Material Certificates: For each of the following, signed by manufacturers:
 - a. Repair materials.
 - b. Liquid floor treatments.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.

1.05 QUALITY ASSURANCE

- A. Applicator's Qualifications: Company specializing in performing work of this Section with 3 years minimum experience.
- B. Coordination: Test compatibility of sealer with adhesive used for access flooring pedestals.
- C. Certifications:
 1. Submit manufacturer's certificate stating proper amount of materials was ordered and shipped to Project.
 2. Submit sealer manufacturer's certificate indicating review of Project conditions and intent to issue extended warranty. Submittal of certificate is required prior to application of materials.

1.06 MOCK-UPS

- A. Mock-up Samples:

1. Cast and finish three 48 inch (1219.20 mm) by 48 inch (1219.20 mm) sample panels for Architect's review of color consistency and workmanship. Provide workmanship and procedures necessary to match Architect approved submittal.
- B. Maintain accepted sample application during construction as standard for Work.
- C. Architect's Review:
1. Architect will review field sample for visual acceptance of materials and workmanship.
 2. Replace unsatisfactory Work as directed by Architect.
 3. Approved samples may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.08 SCHEDULING

- A. Schedule application of products at proper time intervals after concrete finishing and curing operations.
- B. Maintain proper moisture content of concrete before, during, and after application of specified products.

PART 2 PRODUCTS

2.01 LIQUID FLOOR TREATMENTS

- A. Water Based Acrylic Sealing Compounds:
1. ASTM C1315, Type I, Class A, VOC compliant, free of natural or petroleum waxes. Dries clear with satin sheen.
 2. Compatible with subsequent coatings and toppings.
 3. VOC Requirement: Less than 100 g/L
 4. Provide gray tint.
 5. Acceptable Products:
 - a. Euclid Chemical Company; Super Diamond Clear VOX.
 - b. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - c. W. R. Meadows; VOCOMP-30.
 - d. Monopole; MonoChem AquaSeal W20.
 - e. Monopole; MonoChem PermaSeal.
 - f. Approved equal.
- B. Sealers: Only use sealers in the building that meet or do not exceed the VOC limits of the CURRENT requirements of SCAQMD 1113 on the interior of the building and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
1. Current requirement refers to the date on which the materials are installed in the building.
 2. SCAQMD 1113 referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green is current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
 3. Interior refers to all building construction that is inside of the exterior weatherproofing material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 01 7000 - Execution and Closeout Requirements.

- B. Verify that surfaces are clean, dry, dust free, and free of efflorescence, oil or other matter detrimental to sealer application.
- C. Verify that joint sealant work in adjoining surfaces is complete prior to applications of sealers. Delay application until sealants have cured.
- D. Ensure concrete has cured for time period required by manufacturer of product to be applied 28 days minimum before application of products.

3.02 PREPARATION

- A. Provide protection as necessary to protect adjacent materials and surfaces from dirt, dust, and other surface or physical damage.
- B. Prevent migration of airborne materials by use of tarpaulins, wind breaks, and similar containment devices.
- C. Maintain control of concrete chips, dust and debris. Collect water to prevent damage to adjacent surfaces.
- D. Remove loose particles, foreign matter, and oil by method which will not affect sealer application.
- E. Prepare surfaces in accordance with manufacturer's directions.

3.03 SEALING

- A. Apply sealed concrete finish system to cured and prepared slabs to match accepted mockup.
 - 1. Apply penetrating liquid floor treatment for sealed concrete in sealing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.

3.04 ADJUSTING

- A. Repair or replace adjacent Work which has been damaged by finishing operations.

3.05 CLEANING

- A. Clean-up and remove debris daily.
- B. Clean spillage, overspray, or drift from adjacent surfaces; remove immediately in accordance with manufacturer's instructions

3.06 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 3543**POLISHED CONCRETE FLOOR FINISHING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Polished concrete finishing, including staining.
 - 1. Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures is specified in Section 03 3000 - Cast-in-Place Concrete.
 - 2. Initial finishing and curing, is specified in Section 03 3500 - Concrete Finishing.

1.02 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Polished concrete finishing Subcontractor.
 - 2. Conduct in conjunction with cast-in-place pre-installation conference to discuss the following:
 - a. Specific mix design.
 - 1) Polished Concrete Floors: Type I portland cement; less than 15 percent fly ash, pozzolan, slag cement, and silica fume; should not be air entrained; compressive strength greater than or equal to 3,500 psi (24.1 MPa); maximum water-cementitious materials (w/c) ratio of 0.45.
 - b. Floor flatness and levelness criteria.
 - c. Specified curing methods/procedures.
 - d. Projected 3, 10, and 28 day compression strength test related to specified aggregates exposure for finished floor and project phasing.
 - e. Protection of concrete substrate during construction and prior to polishing process
 - f. Project phasing and scheduling for each step of grinding, honing and polishing operations including, but not limited to:
 - 1) Quality of qualified personnel committed to project.
 - 2) Quality and size of grinders committed to project.
 - 3) Proper disposal of concrete slurry and/or concrete dust.
 - g. Details of each step of grinding, honing, and polishing operations.
 - 1) Application of color.
 - 2) Application of liquid applied products.
 - h. Protecting polished concrete floors after polishing work is complete.
 - i. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.
 - 3. Arrange for manufacturer's technical representative to be on Project site to advise applicator of proper procedures and precautions and to observe application methods of products.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.

2. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
3. Samples for Initial Selection: For each type of product requiring color selection.
4. Samples for Verification: For each type of exposed color.

B. Informational Submittals:

1. Qualification Data: For Installer.
2. Material Certificates: For each of the following, signed by manufacturers:
 - a. Repair materials.
 - b. Stain materials.
3. Liquid floor treatments.

1.05 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.06 QUALITY ASSURANCE

- A. Applicator's Qualifications:
 1. Experience: Company experienced in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.
 2. Supervision: Maintain competent supervisor who is at Project during times specified work is in progress, and is currently certified as Craftsman or Master Craftsman by Concrete Polishing Association of America (CPAA).
 3. Manufacturer Qualification: Approved by manufacturer to apply liquid applied products.
- B. Certifications:
 1. Submit manufacturer's certificate stating proper amount of materials was ordered and shipped to Project.
 2. Submit polished concrete manufacturer's certificate indicating review of Project conditions and intent to issue extended warranty. Submittal of certificate is required prior to application of materials.
 3. Submit polished concrete manufacturer's certificate indicating review of Project conditions and stating that supplied system will meet the performance requirements including the required minimum wet dynamic coefficient of friction.
- C. Walkway Auditor: Certified by CPAA or NFSI to test bonded abrasive polished concrete floors for wet dynamic coefficient of friction according to ANSI B101.3.
- D. Coefficient of Friction: Achieve following coefficient of friction by field quality control testing in accordance to the following standards:
 1. ANSI B101.3 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials - Achieve a minimum of 0.42 for level floor surfaces.
- E. Source Limitations: Obtain primary terrazzo materials through one source from a single manufacturer. provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- F. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of aggregate in common batch from one source with resources to provide materials of consistent quality in appearance and physical properties.

1.07 MOCK-UPS

- A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 inches (1219.20 mm) by 48 inches (1219.20 mm) minimum, to demonstrate the expected range of finish, color, and appearance variations.
 - 1. Locate panels as indicated or, if not indicated, as directed by Architect.
 - 2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Demolish and remove field sample panels when directed.
- B. Mock-ups: Before casting concrete, build mock-ups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mock-ups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mock-ups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Demonstrate curing, finishing, and protecting of polished concrete.
 - 3. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.09 WARRANTY

- A. Warrant polished concrete system to be free of defects related to material deficiency and workmanship for 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Advanced Floor Products, Inc.: www.retroplatesystem.com.
 - 2. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.: www.lmcc.com.
 - 3. Prosoco Inc.: prosoco.com.
 - 4. Vexcon Chemicals, Inc.: www.vexcon.com.
 - 5. Approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Improve performance of floor by installation of polished concrete floor system as measured by the following criteria:
 - 1. Wet Dynamic Coefficient of Friction (DCOF): Provide products with the following value as determined by testing identical products by the DCOF AcuTest Method per ANSI 137.1, 2012 Edition.
 - a. Walkway Surfaces: Minimum 0.42.
 - 2. General: The following terms apply to this Section. Gloss level shall be determined according to CSDA ST 115.
 - a. Gloss Level (Low Polish): Mock-up to determine final Ra number and refinement. Ra number to be logged and kept for final comparison.
 - 3. Finish surfaces to the following tolerances for suspended slabs, according to ASTM E1155, for a randomly trafficked floor surface:

- a. Specified Overall Values (SOV):
 - 1) Flatness: FF 50.
 - 2) Levelness: FL 30.
- b. Minimum Local Values (MLV):
 - 1) Flatness: FF 35.
 - 2) Levelness: FL 20.

2.03 POLISHED CONCRETE SYSTEM

- A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of specified sheen. Materials and process include grinding, application of hardener, densifier, stain guard, surface honing, polishing, application of a micro-filming coating, and final polishing.
 - 1. Concrete Mix for Polished Floor Finish: Confirm polished concrete system manufacturer's requirements for concrete mix design specified in Section 03 3000; make necessary adjustments to specified mix design, if necessary, to comply with accepted manufacturer's requirements.
 - 2. Acceptable Systems:
 - a. Advanced Floor Products, Inc.; Retro Plate System.
 - b. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.; FGS Permashine Concrete Polishing System.
 - c. Prosoco Inc.; Consolideck Concrete Flooring System: prosoco.com.
 - d. Approved equal.

2.04 STAIN MATERIALS

- A. Comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Penetrating Stain: Water-based, acrylic latex, penetrating stain with colorfast pigments.
 - 1. Acceptable Products:
 - a. Brickform; a division of Solomon Colors; Freestyle PRO Stain.
 - b. Butterfield Color; Elements Transparent Concrete Stain.
 - c. Duckback Products; Mason's Select Transparent Acrylic Concrete Stain 6000 Series.
 - d. H&C Concrete Care Products; Semi-Transparent Decorative Stains.
 - e. Increte Systems Inc.; Vibra-Stain.
 - f. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.; Vivid Concrete Dye.
 - g. L. M. Scofieldn Company; Formula One Liquid Dye.
 - h. Prosoco Inc.; Consolideck GemTone Stain.
 - i. Westcoat Specialty Coating Systems, Inc.; SC-37 Nano Stain: www.westcoat.com.
 - j. Approved equal.

2.05 LIQUID HARDNER/DENSIFIER

- A. Liquid Densifier: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - 1. Basis of Design Product:
 - a. Advanced Floor Products; Retro Plate 99.
 - b. Curecrete Distribution, Inc.; Ashford Formula.
 - c. Euclid Chemical Company (The); an RPM company; Euco Diamond Hard.
 - d. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - e. Prosoco Inc.; LS.
 - f. Approved equal.

2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sealers: Only use sealers in the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District SCAQMD 1113 on the interior of the building and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
1. Current requirement refers to the date on which the materials are installed in the building.
 2. SCAQMD 1113 referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green is current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.

2.06 FINISH COATING

- A. High Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
1. Composition: Acrylic polymer-based.
 2. Acceptable Products:
 - a. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.; Permguard SPS: www.lmcc.com.
 - b. Prosoco Inc.; Consolideck Concrete Flooring System: prosoco.com.
 - c. Approved equal.

2.07 ACCESSORIES

- A. Brass or bronze inlay strips 1/8 inch wide.
- B. Patching Compound: Compound composed of 40 percent portland cement, 45 percent limestone, and 15 percent vinyl acetate copolymer, when mixed with dust salvaged from grinding process forms a paste that hardens when surface imperfections are filled.
- C. Grout Material: Clear modified silicate sealant, containing no pore clogging latex, when mixed with dust salvaged from grinding process forms a paste that reacts with calcium hydroxide in concrete that hardens when surface imperfections are filled.
- D. Protective Cover: Non-woven, puncture and tear resistant, polypropylene fibers laminated with a multi-ply, textured membrane, not less than 18 mils in thickness.

2.08 POLISHING EQUIPMENT

- A. Field Grinding and Polishing Equipment:
1. Variable speed, multiple head, counter-rotating, walk-behind machine with not less than 600 pounds (272 kg) of down pressure on grinding or diamond polishing pads.
 2. If dry grinding, honing, or polishing, use dust extraction equipment with flow rate suitable for dust generated, with squeegee attachments.
 3. If wet grinding, honing, or polishing, use slurry extraction equipment suitable for slurry removal and containment prior to proper disposal.
- B. Edge Grinding and Polishing Equipment: Hand-held or walk-behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.
- C. Burnishing Equipment: High speed walk-behind or ride-on machines capable of generating 1000 to 2000 revolutions per minute and with sufficient head pressure of not less than 20 pounds to raise floor temperature by 20 degrees F.
- D. Diamond Tooling: Abrasive tools that contain industrial grade diamonds within a bonded matrix (such as metallic, resinous, ceramic, etc) that are attached to rotating heads to refine the concrete substrate.
1. Bonded Abrasive: Abrasive medium that is held within a bonding that erodes away to expose new abrasive medium as it is used.

- E. Resin Bond Tooling: Diamond tooling that contains industrial grade diamonds within a resinous bonded matrix (poly-phenolic, ester-phenolic, thermoplastic-phenolic) that is attached to rotating heads to refine the concrete substrate. Resin bond tooling does not have the soft/medium/hard characteristics of metal bond tooling and are typically used for the later honing and polishing stages of the polishing process.
- F. Hybrid Tooling: Diamond tooling that combines metal bond and resin bond that has the characteristics of both types of tooling. These types of tools are typically used as either transitional tooling from metal bond tools to resin bond tools or as a first cut tool on smooth concrete surfaces.
- G. Transitional Tooling: Diamond tooling that is used to refine the scratch pattern of metal bond tooling prior to the application of resin bond tooling in an effort to extend the life of resin bond tooling and to create a better foundation for the polishing process.
- H. Metal Bonded Pads: Grinding pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.
- I. Resin Bonded Pads: Polishing pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.
- J. Burnishing Pads: Maintenance pads for use with high speed burnishing equipment.
- K. Abrasive Pad: An abrasive pad, resembling a typical floor maintenance burnishing pad, that has the capability of refining the concrete surface on a microscopic level that may or may not contain industrial grade diamonds. These pads are typically used for the maintenance and/or restoration of previously installed polished concrete flooring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 01 7000 - Execution and Closeout Requirements.
- B. Ensure concrete has cured for sufficient amount of time before commencing polishing operations in order to match texture of approved sample.
- C. Verify that damage and defects in concrete surface have been repaired as specified in Section 03 3000 - Cast-in-Place Concrete and accepted by Architect.
- D. Cementitious Surfaces: Verify that substrates are dry enough and ready for polishing installation by testing for moisture and pH.
 - 1. Ensure concrete has cured 60 days minimum.
 - 2. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
 - 3. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- E. Verify that surfaces are clean, dry, dust free, and free of efflorescence, oil or other matter detrimental to sealer/hardener application.
- F. Verify that joint sealant work in adjoining surfaces is complete prior to applications of sealers. Delay application until sealants have cured.

3.02 PREPARATION

- A. Cleaning New Concrete Surfaces:
 - 1. Prepare and clean concrete surfaces.

2. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, paint splatter, and other contaminants incompatible with liquid applied products and polishing.
- B. Fill joints and saw cut joints with epoxy resin prior to being ground.
 - C. Provide protection as necessary to protect adjacent materials and surfaces from dirt, dust, and other surface or physical damage.
 - D. Remove loose particles, foreign matter, and oil by method which will not affect sealer/hardener application.
 - E. Prepare surfaces in accordance with manufacturer's directions.
 - F. Provide protection as necessary to protect adjacent materials and surfaces from dirt, dust, spillage, overspray and other surface or physical damage.
 - G. Once polished concrete flooring operations begin, do not allow construction traffic in work area until floor is completely finished and covered with protective materials to prevent damage and staining.

3.03 POLISHING

- A. General: Grind and polish concrete in accordance with manufacturer's written instructions and use same procedures and personnel used in creating approved field sample. Approved sample will be used to judge acceptability of polished concrete finishing
- B. Polish Level:
 1. Concrete: Level 3: High sheen, 800 grit.
- C. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 - a. Aggregate Exposure: Class B - Fine Aggregate - Fine aggregate exposure with little to no medium aggregate exposure at random locations

3.04 SCORE JOINTS

- A. Score Joints: Saw cut 1/8 inch (3.17 mm) wide by 1/2 inch (12.7 mm) deep.

3.05 STAINING

- A. Newly placed concrete shall be at least 30 days old before staining.
- B. Prepare surfaces according to manufacturer's written instructions and as follows:
 1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
 2. Prepare surfaces to a profile equal CSP 2 or CSP-3 by grinding, sanding, or abrasive blasting. Test and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
 3. Vacuum surface entirely and ensure that any dust or contaminants are removed, as these will deter adhesion.
- C. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
 1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
 2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

- D. Seal concrete in accordance with Section 03 3541 - Concrete Sealing.

3.06 FINISHING

- A. Apply finishes in accordance with Manufacturer's written instructions.
- B. Apply two coats of liquid densifier according to manufacturer's written instructions, allowing recommended drying time between successive coats.
- C. Allow to dry 48 hours.
- D. Remove defects and re-polish defective areas.
- E. Finish edges of floor finish adjoining other materials in a clean and sharp manner.
- F. Apply finish coating with microfiber pad. Allow to dry 4 hours.
- G. Apply additional coats as required.
- H. Burnish after final coat has dried 4 hours minimum, use high speed, 2000 RPM burnisher with soft white pad or soft natural hogs hair.

3.07 FIELD QUALITY CONTROL

- A. Field Testing: Engage a qualified walkway auditor to perform field testing to determine if polished concrete floor finish complies with specified static coefficient of friction.
 - 1. ANSI B101.3 for dynamic coefficient of friction.

3.08 ADJUSTING

- A. Repair or replace adjacent Work which has been damaged by finishing operations.

3.09 CLEANING

- A. Clean-up and remove debris daily.
- B. Clean spillage, overspray, or drift from adjacent surfaces; remove immediately in accordance with manufacturer's instructions.

3.10 PROTECTION

- A. Protect finished work in accordance with Section 01 7000 - Execution and Closeout Requirements.
- B. Once polished concrete flooring operations begin, do not allow construction traffic in work area until floor is completely finished and covered with vapor permeable protective materials to prevent damage and staining.
- C. Protect finished concrete surfaces from damage by construction equipment and operations.
- D. Covering: After completion of polishing, protect polished floors from subsequent construction activities with vapor permeable protective covering.

END OF SECTION

**SECTION 04 0511
MORTAR AND MASONRY GROUT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 RELATED REQUIREMENTS

- A. Section 04 2001 - Masonry Veneer: Installation of mortar.
- B. Section 08 1113 - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
 - a. Include product data for integral water repellent admixture, indicating compliance with specified performance requirements.
 - 2. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - a. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C 1506 for water retention, and ASTM C91/C91M for air content.
 - b. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- B. Informational Submittals:
 - 1. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
 - 2. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
 - 3. Mix Designs: For each type of mortar[and grout]. Include description of type and proportions of ingredients.
 - a. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
 - b. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
 - 4. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - a. Mortar admixtures.
 - b. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - c. Grout mixes. Include description of type and proportions of ingredients.

1.04 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the Contract Documents.
 - 1. Maintain one copy of each document on project site.

1.05 PRECONSTRUCTION TESTING

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 4000 - Quality Requirements.
- B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
 - 1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.
- C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
 - 1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.
- B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

1.07 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

- A. Use only factory premixed packaged dry materials for mortar and grout, with addition of water only at project site.
- B. Mortar Mix Designs: ASTM C270, Property Specification:
 - 1. Type S.
- C. Grout Mix Designs:
 - 1. Bond Beams and Lintels: 2000 psi (13.78 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.

2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Type: Type S.
 - 2. Color: Mineral pigments added as required to produce approved color sample.
 - a. Match CMU.
- B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
- C. Water: Clean and potable.

2.03 ADMIXTURES

- A. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar and grout at the time of manufacture; designed to reduce capillarity without reducing flexural bond strength.
 - 1. Performance of Mortar and Grout with Integral Water Repellent:

- a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
 - 1) No water visible on back of wall above flashing at the end of 24 hours.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.
 - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
- b. Flexural Bond Strength: ASTM C1357; minimum 10 percent increase.
- c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
- d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
- 2. Use only in combination with masonry units produced with integral water repellent admixture.
- 3. Acceptable Products:
 - a. ACM Chemistries; RainBloc for Mortar: www.acmchem.com.
 - b. BASF Construction Chemicals MasterPel 240MA (Pre-2014: Rheapel Plus Mortar Admixture) or MasterPel 210D (Pre-2014: Rheapel Plus D): www.construction-chemicals.basf.com.
 - c. Grace Construction Products; Dry-Block Mortar Admixture: www.gcpat.com.
 - d. Approved equal.

2.04 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
- D. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
 - 1. Include specified water repellent admixture.
- E. Do not use anti-freeze compounds to lower the freezing point of mortar.
- F. If water is lost by evaporation, re-temper only within two hours of mixing.

2.05 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

PART 3 EXECUTION

3.01 PREPARATION

- A. Plug clean-out holes for grouted masonry with block masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

- A. Install mortar and grout to requirements of Sections in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches (400 mm) without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.

- E. Remove excess mortar from grout spaces.

3.03 GROUTING

- A. High-Lift Grouting:
 - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 - 2. Limit height of pours to 60 inches (1524 mm).
 - 3. Provide cleanouts for grout lifts exceeding 48 inches (1220 mm).
 - 4. Place grout for spanning elements in single, continuous pour.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 4000 - Quality Requirements.
- B. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- C. Test and evaluate mortar in accordance with ASTM C780 procedures.
 - 1. Test with same frequency as specified for masonry units.
- D. Test and evaluate grout in accordance with ASTM C1019 procedures.
 - 1. Test with same frequency as specified for masonry units.
- E. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.
- F. Inspections: Special inspections according to Level B in TMS 402/602/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C78/C78M.
- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C78/C78M. Test mortar for compressive strength.

END OF SECTION

SECTION 04 2600
SINGLE-WYTHE UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete masonry units.
- B. Reinforcement, anchorage, and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
- B. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2017a.
- C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Direct and coordinate placement of metal anchors supplied for installation under other Sections.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Require attendance by all relevant installers.
 - 3. Require attendance of parties directly affecting work of this Section.
 - 4. Review conditions of installation, installation procedures, and coordination with related work.

1.04 SUBMITTALS

- A. Action Submittals:
- B. Product Data: Provide data for decorative and pre-faced masonry units and fabricated wire reinforcement.
 - 1. Include product data for integral water repellent admixture, indicating compliance with specified performance requirements.
- C. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Samples: Submit four samples of decorative block units to illustrate color, texture and extremes of color range.
- D. Informational Submittals:
 - 1. Material Certificates: Certify that products meet or exceed specified requirements. For each type and size of the following:
 - a. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
 - b. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
 - c. Reinforcing bars.

- d. Joint reinforcement.
 - e. Anchors, ties, and metal accessories.
 - f. Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
2. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.05 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 2. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 3. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.
 - 4. Section A5.405.5: Provide documentation that cement and concrete used are made with recycled content and/or alternative energy.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each document on project site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- D. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- E. Handle and store pre-faced concrete block units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

1.08 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Increase extent of cover in subparagraph below as needed to suit local climatic conditions.
 - 2. Extend cover a minimum of 24 inches (610 mm) down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 x 8 inches (400 x 200 mm) and nominal depth of 8 inches (200 mm).
 - 2. Special Shapes: Provide non-standard blocks configured for corners.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block.
 - b. Exposed Faces CMU Type 1: Smooth.
 - 1) Location: Areas of waterproofing.
 - 2) Color: Light tan.
 - 4. Exposed Faces CMU Type 2: Split-Faced.
 - a. Location: Areas exposed to view and as indicated on Drawings.
 - b. Color: Light tan.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
 - a. Acceptable Products:
 - 1) ACM Chemistries; RainBloc for Mortar: www.acmchem.com.
 - 2) BASF Construction Chemicals MasterPel 240MA (Pre-2014: Rheopel Plus Mortar Admixture) or MasterPel 210D (Pre-2014: Rheopel Plus D): www.construction-chemicals.basf.com.
 - 3) Grace Construction Products; Dry-Block Mortar Admixture: www.gcpat.com.
 - 4) Prior approved equal.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 0511.

2.03 REINFORCEMENT

- A. Refer to Structural Drawings.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized steel.
 - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
 - 6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
- C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Acceptable Products:
 - a. Dur-O-Wal; a Hohmann & Barnard company; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products, Inc.; No. 376 Rebar Positioner..
 - c. Hohmann & Barnard, Inc; #RB or #RB-Twin Rebar Positioner.
 - d. Lock Rite; Rebar Positioners.
 - e. Wire-Bond; Core Lock Rebar Positioner or O-Ring or Double O-Ring Rebar Positioner.

2.04 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- C. Proprietary Non-Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Products: Provide one of the following:
 - a. PROSOCO, Inc; Enviro Klean Safety Klean.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that would impair mortar bond.
- C. Verify that related items provided under other sections are properly sized and located.
- D. Verify that built-in items are in proper location, and ready for roughing into masonry work.

- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Layout out walls in advance for accurate pattern of surface bond with uniform joint widths and for accurate location of opening, expansion joints, returns, and offsets. Avoid use of less-than-half size units at corners, jambs and other locations.

3.03 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 1. Bond: Running or as indicated on Drawings.
 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 8 inches (200 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Fill cores in hollow CMUs with grout 24 inches (610 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- E. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install top of wall supports as indicated on Drawings.
- F. Lay hollow masonry units with face shell bedding on head and bed joints.
- G. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

- H. Remove excess mortar as work progresses.
- I. Interlock intersections and external corners, except for units laid in stack bond.
- J. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- K. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- L. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- M. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- N. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 REINFORCEMENT AND ANCHORAGE

- A. Install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches (150 mm).
- E. Reinforce joint corners and intersections with strap anchors 16 inches (400 mm) on center.

3.07 GROUTED COMPONENTS

- A. Place grout in accordance with Structural Drawings.
- B. Lap splices in reinforcing bars as indicated on Drawings.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) either side of opening.

3.08 CONTROL AND EXPANSION JOINTS

- A. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- B. Size control joints as indicated on drawings; if not shown, 3/4 inch (19 mm) wide and deep.

3.09 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).

- E. Maximum Variation of Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.10 CUTTING AND FITTING

- A. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.11 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 4000 - Quality Requirements, will conduct field tests.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

3.12 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.13 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members.
- B. Structural steel support members, sag rods, and struts.
- C. Base plates, shear stud connectors and anchor rods, elevator rail bracing.
- D. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 13 – Architecturally Exposed Steel
- B. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
- C. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.
- D. Section 07 81 00 - Applied Fireproofing: Fireproof protection to framing and metal deck systems.

1.03 REFERENCE STANDARDS

- A. California Code of Regulations, Title 24, Part 2, with DSA Amendments, also known as the California Building Code (CBC), 2019 Edition.
- B. AISC (MAN) - Steel Construction Manual; 2011.
- C. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- D. AISC 360-16 - Specification for Structural Steel Buildings; 2010
- E. AISC 341-16 - Seismic Provisions for Structural Steel Buildings; 2010
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- H. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- L. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014.
- M. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- N. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

- O. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2014.
- P. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.
- Q. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2007 (Reapproved 2013).
- R. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2015.
- S. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- T. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- U. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2015.
- V. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.
- W. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.
- X. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).
- Y. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2013.
- Z. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2015.
- AA. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- AB. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2016.
- AC. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners; 2013.
- AD. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2015.
- AE. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- AF. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- AG. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- AH. AWS D1.8 - Structural Welding Code - Seismic Supplement, 2009
- AI. AWS QC1 - Standard for AWS Certification of Welding Inspectors
- AJ. AWS A5 - Filler Metal Specifications
- AK. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2015.
- AL. ITS (DIR) - Directory of Listed Products; current edition.

- AM. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with April 2015 Errata.
- AN. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- AO. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- AP. SSPC-SP 1 - Solvent Cleaning; 2015.
- AQ. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- AR. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).
- AS. SSPC-SP 7 - Brush-Off Blast Cleaning; 2007.
- AT. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Plans of all levels showing dimensioned location of edge of slab, deck, and openings. Submit prior to Shop and Erection drawings.
- C. Shop Drawings:
 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 2. Indicate cambers.
 3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
 4. Identification of high-strength bolted joints as snug-tight, pretensioned or slip-critical, as required by the Contract Documents.
 5. Locations where the Construction Documents require backing bars to be removed.
 6. Locations where the Construction Documents require supplemental fillet welds where backing is permitted to remain.
 7. Locations where the Construction Documents require weld tabs to be removed.
 8. Identification of members and connections of the Seismic-Load-Resisting System.
 9. Location and dimensions of the Protected Zone.
 10. Identification of welds in the Seismic-Load-Resisting System.
 11. Identification of Demand-Critical Welds.
 12. Identification of connections and members, or portions thereof, to be treated as AESS.
 13. Shop and erection drawings shall clearly identify revisions and revision dates in accordance with AISC 303-10.
 14. Shop drawings shall include the following additional information:
 - a. Complete information necessary for the fabrication of members including cuts, copes, holes, stiffeners, and camber.
 - b. Surface preparation and finishes, including both painting and grinding.
 - c. Material grades of all members, connection material, fasteners, and weld filler metal.
 - d. Connection details drawn to scale for members of the Seismic-Load-Resisting System.
 - e. With each set of shop drawings include corresponding erection drawings identifying pieces.
 15. Erection drawings shall include the following additional information:
 - a. Identification mark of members.
 - b. Orientation and relation of members to appropriate grid lines.
 - c. Setting elevations for column bases.
 - d. Standard and special details for field connections.
 - e. Identification of joints or groups of joints in which a specific assembly order, welding sequence, welding technique, or other special precautions are required.
- D. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

- E. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- F. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
- G. Welding Consumables: Submit the following items:
 - 1. Manufacturer's Certifications for electrodes, fluxes and shielding gasses to be used. Certifications shall satisfy AWS A5 requirements. In addition submit a Certificate of Compliance from the Contractor supplying the materials. Submit certifications that the product meets any additional requirements of the project.
 - 2. Manufacturer's product data sheets for all welding material to be used. The data sheets shall describe the product, limitations of use, recommended welding parameters, and storage and exposure requirements, including baking and rebaking.
- H. Welded Stud Connectors: Submit the following items:
 - 1. Manufacturer's Certification that the studs, as supplied, meet the requirements of AWS D1.1.
 - 2. Certified copies of the stud manufacturer's test reports covering the last completed set of in-plant quality control mechanical tests for the diameter supplied.
 - 3. Certified material test reports from the manufacturer. The Manufacturer's Certification shall be accompanied by a Certificate of Compliance from the Contractor.
- I. Bolting and Welding Procedures: Procedures shall assign responsibility to a person or position and shall contain enough detail to be useful to the workforce without reference to governing specifications. The procedures need not act as work instructions. Procedures shall be dated and indicate the person or position that has the authority to maintain the procedure.
 - 1. Fastener Installation Procedures: Submit written procedures for the pre-installation testing, installation, snugging, pre-tensioning, and post-installation inspection of high strength fasteners.
 - 2. Welding Procedure Specifications (WPSs): Welding Procedure Specifications (WPSs) shall conform to the requirements of AWS D1.1. Submit Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQR) as required by AWS D1.1, to be used on the project to the District's Testing Agency.
 - 3. Use forms provided in Annex E of AWS D1.1 or equivalent.
 - 4. Weld Sequence Procedures: Submit written procedures indicating field welding sequences for each type of connection with multiple field-welded joints, and the sequence of such connections to be field-welded at each level.
 - 5. Weld Shrinkage and Distortion Control Plan: Where shrinkage is likely to cause distortion or other problems, submit a mitigation plan. The contractor is responsible for determining conditions requiring a Weld Shrinkage and Distortion Control Plan.
- J. Welding Performance Qualification Records (WPQRs):
 - 1. Written Welding Performance Qualification Records (WPQRs), in accordance with AWS D1.1, for all welders on the project. Submit documentation that the welder has passed all designated supplemental welder qualification testing required for the types of welding to be performed. Submit documentation showing that the welder continued to use the applicable welding process on an ongoing basis since the WPQR test was conducted.
- K. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- L. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Quality Requirements in accordance with Section 01 40 00.
- B. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

- C. Comply with Section 10 of AISC S303 "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- D. Maintain one copy of each document on site.
- E. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- F. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
- G. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- H. Welders: Welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and the CBC.
 - 1. Welders shall have a valid Welding Performance Qualification Record (WPQR) for each welding procedure to be performed.
 - 2. Welders whose work fails to pass inspection shall be requalified before performing further welding.
 - 3. Supplemental Welding Personnel Testing: Welders and welding operators performing work on bottom-flange Demand-Critical Welds shall pass Supplemental Welder Qualification Testing, as prescribed in AWS D1.1, D.1.8 using the process and highest deposition rate to be used in the work. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification. Tack welders need not perform such Supplemental Testing.
 - 4. Qualification Period: Personnel who have not welded for a period of three or more months shall be requalified. Welding personnel required to be tested using the Supplemental Welding Personnel Testing shall be qualified by test within 12 months prior to beginning welding on the project.
 - 5. The Contractor shall pay costs of certifying qualifications and requalifications.
- I. Welding Inspector Qualifications:
 - 1. All Welding Inspectors shall be trained and thoroughly experienced in inspecting welding operations, and qualified as Certified Welding Inspectors (CWI) in accordance with AWS D1.1, AWS D1.8 and AWS QC1.
 - 2. NDT Personnel Qualifications
 - a. NDT personnel shall be qualified under one of the ASNT documents referenced in this specification. NDT performed by NDT Level I personnel shall be under the close, direct supervision of an NDT Level II.
 - b. Demand-Critical Welds: UT may be performed only by UT technicians certified as Level II by their employer, or as ASNT Level III certified by examination by the ASNT. Ultrasonic testing technicians who perform flaw detection or sizing shall be trained in applicable UT procedure and shall demonstrate their competence through testing as prescribed in AWS D1.8.
- J. Bolting Inspector Qualifications: Competency shall be demonstrated through the administration of a written examination and through the hands-on demonstration by the Inspector of the methods to be used for bolt installation and inspection.
- K. Submittals: The District's Testing Agency will submit the following items:
 - 1. Quality Assurance Plan: The Quality Assurance Plan shall contain the Quality Assurance and Inspection items contained in this Section.
 - 2. Qualifications of District's Testing Agency management and personnel designated for the project.
 - 3. Qualification records for District's Testing Agency's Inspectors and NDT technicians designated for the project.
 - 4. District's Testing Agency's Quality Control Plan for the monitoring and control of the Agency's operations.

5. Written Practice for District's Testing Agencies: The District's Testing Agency shall maintain a Written Practice for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualification and certification of inspection personnel, including those of subcontracting agencies. The Written Practice shall also describe the Agency's procedures for determining the acceptability of the structure in accordance with the applicable codes, standards, and specifications. The Written Practice shall also describe the Agency's inspection procedures, including general inspection, material controls, visual welding inspection, and bolting inspection.
 - a. Bolting Inspection Procedures: Comply with RCSC Specification and the Quality Assurance Plan.
 - b. Welding Inspection Procedures: Meet the requirements of the AWS D1.1, AWS D1.8 and the Quality Assurance Plan.
 - c. Nondestructive Testing Procedures: The Written Practice shall describe the responsibility of each level of certification for determining the acceptability of material and welds in accordance with the applicable codes, standards, specifications and procedures.

1.06 STRUCTURAL STEEL PRE-CONSTRUCTION CONFERENCE

- A. Prior to performing any fabrication or erection work, the District's Representative, Architect, Structural Engineer, and District's Testing Agency, together with Steel Fabricator personnel and Steel Erector personnel supervising the shop, field and Quality Control work shall hold a Pre-construction Conference to review submittal requirements, welding procedures, bolting procedures, fabrication and erection issues, and inspection requirements for all structural steel operations.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle packaged materials in original containers with seals unbroken and labels intact until time of use.
- B. Structural steel shall be stored and handled in a manner that prevents damage or distortion. Discharge materials carefully; do not dump onto ground.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to members of the supporting structure.
- D. Store structural steel members, whether on or off site, above ground on platforms, skids, or other support; store other materials in weather-tight, dry place until use.
- E. Store materials to permit easy access for inspection and identification.
- F. Electrode Requirements:
 1. Packaging of weld filler metals shall conform to the requirements of AWS D.1.1. FCAW electrodes shall be received in undamaged moisture-resistant containers. They shall be protected against contamination and injury during shipment and storage. When removed from protective packaging and installed on machines, care shall be taken to protect the electrodes and coatings from deterioration or damage.
 2. Modification or lubrication of an electrode after manufacture is not permitted, except that drying shall be permitted when recommended by the manufacturer.
 3. Electrode Storage and Exposure Limits for Demand-Critical Welds: The exposure time limit for FCAW electrodes shall be based upon the results of tests as prescribed in AWS D1.1 and D1.8. Spools shall be identified to facilitate monitoring of total atmospheric exposure time. FCAW electrodes that have been exposed for periods exceeding the allowable atmospheric exposure may be baked as per D1.1 if manufacturer's testing and recommendations show that baking is effective.
- G. Fasteners shall be stored in a protected place. Except for ASTM F1852 "twist-off" type assemblies, clean and relubricate bolts, nuts and washers that become dry or rusty before use.

F1852 fastener components may be relubricated following the manufacturer's written instructions, and must be retested after relubrication and prior to use to verify suitability for installation.

1.08 JOB CONDITIONS

- A. Provide the District's Testing Agency with free access to places on and off job site where materials are stored or fabricated, to places where equipment is stored or serviced, and to job site.
- B. Sequencing, Scheduling:
 - 1. Notify the Architect and District's Testing Agency in sufficient time prior to shop or field fabrication and erection to permit testing and inspection without delaying Work.
 - 2. Ensure timely delivery of items to be embedded in work of other sections; furnish setting drawings and directions for installation
 - 3. Provide templates for setting of anchor rods.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- D. Steel Shapes, Plates, and Bars: ASTM A36 carbon structural steel, Grade 36. Plates for seismic load resisting system: ASTM A572 high-strength, low-alloy structural steel Grade 50
- E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- F. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded.
- G. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade 30 cold-rolled.
- H. Pipe: ASTM A53/A53M, Grade B, Finish black.
- I. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
- J. Sag Rods: ASTM A36/A36M.
- K. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.
- L. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
- M. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
- N. Unheaded Anchor Rods: ASTM F1554, Grade 55, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
- O. Headed Anchor Rods: ASTM A307, Grade C, plain.
- P. Load Indicator Washers: Provide washers complying with ASTM F959 at connections requiring high-strength bolts.
- Q. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
 - 1. Comply with AWS D1.1 with a nominal 70 ksi tensile strength.
 - 2. Supplemental Requirements for the Seismic-Load-Resisting System (SLRS or LFRS) as noted on plan:

- a. Toughness and Elongation: Weld filler metals shall be capable of providing welds with the following minimum mechanical property requirements using AWS A5 classification test methods:
 - 1) CVN toughness of 20 ft-lb at minus 20° F
 - 2) Elongation: 22% minimum.
 - b. Weld filler metals shall be low-hydrogen per AWS D1.1.
 - c. Weld procedures shall conform to the Hydrogen Control Method in AWS D1.1 Annex XI.
 - d. All welds used in members and connections in the LFRS shall be made with filler metals meeting the requirements specified in AWS D1.8 Clause 6.3. AWS D1.8 Clauses 6.3.5, 6.3.6, 6.3.7, and 6.3.8 shall apply only to demand critical welds.
 - 3. Demand-Critical Welds (as noted on plan): In addition to the requirements for Seismic-Load-Resisting System (SLRS) welds, employ weld filler metals capable of providing welds with a minimum CVN toughness of 40 ft-lb at 70° F, using AISC 341, AWS D1.8 test conditions and specimens in lieu of those in AWS A5. Demand critical welds shall be made with
- R. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
- 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
 - 3. Height Change, Plastic State; when tested according to ASTM C827/C827M:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.
- S. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- T. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Coordinate as required for attachment of other work to structural steel.
- C. Where required for passage of reinforcing steel shapes, sections, plates, or bars, drill or punch holes as indicated on Contract Drawings. Notify Architect of conditions not shown or noted.
- D. Allowable Tolerances: Comply with AISC 360, Chapter M, and AISC 303, Section 6. Where more restrictive tolerances are necessary to properly install other building systems and components then adopt the more restrictive tolerances.
- E. Architecturally Exposed Structural Steel (AESS): All structural steel denoted "AESS" on the drawings shall be fabricated in accordance with the requirements of the Specifications.
- F. Holes and attachments to structural steel in areas designated as the Protected Zone are not allowed except as explicitly shown or noted on structural drawings.
- G. Connections:
 - 1. Shop Connections: Bolted or welded as noted.
 - 2. Field Connections: Locate splices only where noted or approved by Architect.
 - 3. To the extent possible, assemble structural steel in the shop prior to galvanization.
- H. Bolted Joints:
 - 1. Punch or drill holes 1/16" larger than bolt size. Material having thickness in excess of connector diameter plus 1/8" shall be drilled rather than punched.
 - 2. Ream unfair holes, but only up to next larger bolt size and install a bolt corresponding to the new hole size. Where unfairness exceeds maximum, weld hole in base material solid and drill hole of proper size.

3. Remove burrs that would prohibit solid seating of connected parts.
 4. Mark completely tightened bolts with identifying symbol.
 5. Provide hardened washers over slotted holes.
 6. Draw up tight, check threads with chisel or provide approved lock washers where bolts are not pretensioned.
 7. Assembly with Standard Threaded Fasteners: Provide beveled washers under bolt heads or nuts resting surfaces exceeding five percent slope with respect to head or nut
 8. Assembly of High-Strength Structural Bolted Joints:
 - a. Meet requirements of RCSC.
 - b. Seismic-Load Resisting System joints shall be slip-critical (friction-type) as defined in RCSC with Class A or better faying surfaces.
 - c. Provide hardened washers under provided under the element turned in the tightening procedure of high strength bolts.
 - d. Direct tension indicator washers, where used, shall be provided under the head of slip-critical high strength bolts.
- I. Welded Construction: (shop and field)
1. Weld in accordance with AISC 360, AWS D1.1, and CBC Chapter 22A.
 2. Welding shall be performed in accordance with the WPS for the joint.
 3. Welds that will be permanently exposed to view shall have burrs, flux, welding oxide air spots, and discolorations removed. Surfaces of such welds shall be reasonably smooth and uniform.
 4. Exterior welds shall be watertight.
 5. Each welder working on the project shall be assigned an identification symbol or mark. Each welder shall mark or stamp this identification symbol at each weld completed. Stamps, if used, shall be the low-stress type.
 6. Before testing, all welds to be subjected to ultrasonic testing (UT) shall be given a visible mark, "for UT," accurately placed on the steel a distance of 4" away from the root of the edge preparation.
 7. Groove welds shall be complete-joint-penetration welds, unless specifically designated otherwise.
 8. WPSs shall be available to welders and inspectors prior to and during the welding process. Prior to welding, joint fit-up shall be verified by the welder for conformance with the WPS and AWS D1.1.
 9. Supplemental Welding Requirements
 - a. Maximum Preheat and Interpass Temperature: The maximum preheat and maximum interpass temperature permitted is 550° F, measured at a distance of 1" from the point of arc initiation. This maximum temperature may not be increased by the WPS, regardless of qualification testing.
 - b. Nonfusible Backing: The use of nonfusible backing materials, including ceramic and copper, is permitted only with satisfactory welder qualification testing performed using the type of backing proposed for use and using the test plate shown in AWS D1.1, Figure 4.21, except that groove dimensions shall be as provided in the WPS and PQR. For nonfusible weld tabs and short segments of nonfusible backing bars used at the ends of welds between shear plates and column faces, or at the ends of continuity plate welds, special welding personnel and welding procedure qualification testing is not required.
 - c. Peening, Controlled Cooling, and Post-Weld Heat Treatment (PWHT): If peening, controlled cooling, or PWHT are used, they shall be performed in accordance with AWS D1.1 and a written procedure for their performance shall be incorporated into the appropriate WPS.
 - 1) If insulating blankets are used to control cooling a written procedure and temperature measurements are not required.
 - 2) The application of heat immediately following completion of a joint to maintain a nominal temperature at or below 550° F is not considered PWHT.

- d. Intermix of Filler Metals: For Demand-Critical Welds in which different weld filler metals are used, supplemental toughness testing shall be conducted as prescribed in AWS D1.8
 - e. Wind Velocity Limits: In the Seismic-Load-Resisting-System, in lieu of the wind speed limitations in AWS D1.1, welds using GMAW, FCAW-G, GTAW and EGW methods shall not be performed when the wind velocity in the immediate vicinity of the weld exceeds three miles per hour. Welding performed within an enclosed area, and not subject to drafts may be deemed to satisfy this requirement. For SMAW, FCAW-S, and SAW processes wind shall not affect the appearance of the molten weld puddle.
10. Welded Joint Details:
- a. Backing bars: The use of backing bars shall be in accordance with AWS D1.1 and D1.8. Backing bars shall be removed where required by the Contract Documents or AWS D1.1 or D1.8.
 - 1) Beam-Column Connection Joints Requiring Removal of Backing Bars: Following removal of backing, remove un-sound weld metal at the root area and any excessive weld discontinuities, and backweld. Minimize gouging and removal of base metal. A reinforcing fillet weld with a minimum leg size of 5/16" or the root opening plus 1/16", whichever is larger, shall be provided. Perform MT on the fillet weld and the immediately adjacent area.
 - 2) If groove weld backing is permitted to remain, the backing shall not exceed ?" thickness. For connections of the seismic-load-resisting system in which backing is not removed, backing shall be attached to the member or plate that does not have its surface prepared for the groove weld. Attachment shall be by either a 1/4" fillet or groove weld along the complete bar length on the side of the bar opposite the groove weld.
 - b. Weld dams are not allowed.
 - c. Weld Tabs:
 - 1) Use of Weld Tabs: Welds shall be terminated at the end of a joint in a manner that will ensure sound welds. Whenever necessary, this shall be done by use of weld tabs.
 - (a) Weld tabs shall extend beyond the edge of the joint a distance equal to a minimum of the part thickness, but not less than 1".
 - (b) Weld tabs shall be oriented parallel to the joint preparation and to the weld direction.
 - (c) Nonfusible weld tabs may be used in applications and locations where qualified in accordance with AWS D1.1, Section 4.
 - 2) SLRS Beam-Column Connection Weld Tab Removal and Finish:
 - (a) Weld tabs of SLRS connections shall be removed. Removal may be performed by air carbon arc cutting (CAC-A), grinding, chipping, or thermal cutting to within 1/8" of the base metal surface. For continuity plate weld tabs, removal within 1/4" of the plate edge is adequate. The process shall be controlled to minimize removal of base metal except for that material immediately adjacent to the weld. The edges where the weld tabs have been removed shall be finished Extra Smooth.
 - (b) In SLRS connections, gouges deeper than 1/16" at locations of removal of weld tabs shall be repaired by welding according to the requirements of this Specification for Deep Gouges. Weld filler metal requirements for Demand-Critical Welds apply. The contour of the weld at the ends shall provide a smooth transition, free of gouges and sharp corners. A minimum radius at the corner need not be provided.
 - (c) Following weld tab removal, finishing, and completion of any necessary repairs, the exposed ends of the weld shall be inspected using magnetic particle testing (MT) or Penetrant Testing (PT).
 - d. Weld toes: Weld toes, whether for groove welds or fillet welds, shall provide a smooth transition between the weld and base metal. The as-welded profile is adequate provided it satisfies the criteria of AWS D1.1, Section 5.24.

- e. Weld access holes:
 - 1) Weld access holes shall meet the dimensional, surface finish, and testing requirements of AISC 360 Chapter J1.6 and AWS D1.1, except as otherwise required by the Contract Documents.
 - 2) Where the height of the weld access hole exceeds the quantity $k-tf+1\frac{1}{2}$ " or where the length of the weld access hole exceeds 4 tf (where k and tf are defined in AISC 360), welded reinforcement is required. Notify the Architect for specific instruction.
 - 3) At welded flange joints that are part of the Seismic Load Resisting System, the weld access hole shall be provided in accordance with AWS D1.8 Part D unless the section is a Heavy Section.
 - 4) The SLRS access hole shall be ground Extra Smooth. Gouges at SLRS access holes shall be repaired according to the requirements of this Specification. Weld filler metal requirements for the Demand-Critical Welds apply.
 - 5) SLRS weld access holes shall be inspected using magnetic particle testing (MT) or liquid penetrant testing (PT) and shall be free of cracks. If a welded gouge repair has been performed, magnetic particle testing (MT) shall be performed.
 - f. Web weld details: A minimum clear distance of $\frac{1}{2}$ " shall be provided between the weld access hole and fillet welds connecting the shear plate and beam web.
 - g. Welding for Moment Connection of Bottom Beam Flange shall be sequenced so as to minimize residual stresses in the joint.
 - h. Weave Passes: Weave passes are not permitted in groove welds in the SLRS.
 - i. Column continuity plate details:
 - 1) If backing bars are used and remain in place, they shall receive a reinforcing fillet weld between the backing bar and column flange. No fillet weld should be placed between backing bar and continuity plate.
 - 2) Weld terminations near the end of the column flange tips may be completed using weld tabs. Weld tabs shall be removed to within $\frac{1}{4}$ " of the continuity plate edge and the surface finished Extra Smooth. Following finishing, the edge shall be inspected using MT. For continuity plate welds, terminations near the internal radius of the member need not be made using weld tabs. Fillet weld terminations between the continuity plate and column web shall be approximately $\frac{1}{4}$ " from each end of the joint
 - j. Tack Welds in the SLRS Protected Zones: Tack welds in the SLRS Protected Zones are permitted only if they are incorporated into a required weld.
- J. Welded Connectors: Install in accordance with AWS D1.1 and manufacturer's recommendations. There shall be no porosity or evidence of lack of fusion between the end of the stud and the steel member.
- K. Develop required camber for members.
- L. Repair of Discontinuities in Protected Zone of Seismic-Load-Resisting System.
- 1. Repair of Discontinuities: If erection aids within the Protected Zone cannot be avoided, the Structural Engineer's approval of the aid's placement, use, and the repair method is required. Air carbon arc gouging is permitted for the removal of welds to within $\frac{1}{8}$ " of the base metal surface. Any remaining weld deposits shall be removed by grinding to a depth $\frac{1}{16}$ " below the surface, faired to adjacent surfaces on a slope not to exceed 1:5.
 - 2. Air Carbon Arc Cutting and Thermal Cutting: Air carbon arc cutting (CAC-A) and thermal cutting is permitted in the Protected Zone with the prior approval of the Structural Engineer for the removal of backing bars and weld tabs, as specified in these documents.
 - 3. Gouges in members and connections in the Seismic-Load-Resisting System shall be repaired according to the requirements of this Specification. Weld filler metal requirements for the Seismic-Load-Resisting System apply, unless otherwise noted.
- M. Surface Finish
- 1. Flush Surfaces: Welds in butt joints required to be flush shall be finished so as to not reduce the thickness of the thinner base metal or weld metal by more than $\frac{1}{16}$ ", or 5% of the

material thickness, whichever is less. Remaining reinforcement shall not exceed 1/32" in height. However, all reinforcement shall be removed where the weld forms part of a faying or contact surface. All reinforcement shall blend smoothly into the plate surfaces with the transition areas free from undercut.

2. Finish Methods and Values: Chipping and gouging may be used, provided these methods are followed by grinding. Where surface finishing is required, surface shall be Extra Smooth, unless otherwise noted or specified in this document. Measurement of surface finish values by visual appearance or tactile comparison is acceptable.
- N. Repair of Gouges: Gouges are not permitted in areas requiring an Extra Smooth finish surface, or where specifically prohibited by AWS D1.1 or this Specification. Repair of gouges meet the following requirements, unless otherwise noted:
1. Shallow Gouges: Gouges up to 3/16" deep shall be removed by grinding as per D1.1, or to a radius of not less than 3/8".
 2. Deep Gouges: Gouges deeper than 3/16" shall be repaired by welding. Prior to welding, gouges shall be ground to provide an Extra Smooth contour with a radius not less than 3/8". The repair area shall be preheated to a temperature between 400° F and 550° F, measured at the point of welding approximately one minute after removal of the heating source, or shall be preheated in accordance with AWS D1.1 Annex XI for high restraint. A written repair WPS for the application shall be followed. Following completion of welding, the area shall be ground Extra Smooth, with fairing of the welded surface to adjoining surfaces where applicable, and shall be inspected using magnetic particle testing (MT).
 3. The transitional slope after gouge removal shall not exceed 1:5.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
- C. Galvanization
 1. Galvanize steel where required by the Drawings or by other sections of the Specification.
 2. Galvanize Shapes in accordance with ASTM A153.
 3. Galvanize Fasteners in accordance with ASTM B695, Class 40 minimum.
- D. Performance Painting: Provide zinc-rich performance painting for exposed steel shapes, members, and fasteners. Refer to Specification Section.

2.04 SOURCE QUALITY CONTROL

- A. Provide shop testing and analysis of structural steel.
- B. The District's Testing Agency will:
 1. Review ladle analysis and certificates of compliance. Where certification is questionable, test material to verify compliance per CBC.
 2. Inspect shop fabrication per CBC Chapter 17A.
 3. Provide the management, personnel, equipment, and services required to perform the quality assurance functions required below.
 4. Verify that no improper attachments to the Protected Zone have been made.
 5. Forward copies of all product and procedure certificates, data sheets, and test and inspection reports to the District, Architect, Structural Engineer, and, Contractor, and DSA.
- C. Welding Inspection: The Welding Inspector will perform the tasks indicated in the following list. This list shall not be considered exclusive of any additional inspection tasks that may be necessary to meet the requirements of AWS D1.1, CBC Chapter 17A and the Quality Assurance Plan
 1. Review and understand the applicable portions of the specifications, the Contract Documents and the shop drawings for the project.

2. Verify that all applicable welder qualifications, welding operator qualifications and tack welder qualifications are available, current, accurate, and in compliance with these specifications.
 3. Verify welder identification and qualification. Verify that any required supplemental welder qualification testing, if required for the joint, has been executed and that the welder has passed.
 4. Verify that each welder has a unique identification mark or die stamp to identify welds.
 5. Verify that all applicable Welding Procedure Specifications (WPSs), with Procedure Qualification Records (PQRs) as needed, are available, current and accurate, and comply with AWS D1.1 and this specification.
 6. Verify that an approved Welding Procedure Specification (WPS) has been provided and that each welder performing the weld has reviewed the WPS. A copy of the appropriate WPS shall be available for each joint, although need not be present at each joint location.
 7. Review mill test reports for all main member and designated connection base material for compliance with the project requirements.
 8. Verify base material identification with the contract documents.
 9. Verify the electrode, flux and shielding gas certifications for compliance with the Contract Documents.
 10. Verify welding consumables with the approved WPSs.
 11. Verify that electrodes are used only in the permitted positions and within the welding parameters specified in the WPS.
 12. Verify that electrodes and fluxes are properly stored, and that exposure limits for the welding materials are satisfied.
 13. At suitable intervals, observe joint preparation, assembly practice, preheat temperatures, interpass temperatures, welding techniques, welder performance and any post-weld controlled cooling and heat treatment to ensure that the requirements of the WPS and AWS D1.1 are satisfied.
 14. At suitable intervals, verify current and voltage of the welding equipment in application of the WPS, if needed, by a calibrated amp and voltmeter. Current and voltage shall be measured near the arc with this equipment.
 15. Inspect the work to ensure compliance with AWS D1.1 and the specified weld acceptance criteria.
 16. Schedule NDT technicians in a timely manner, after the visual inspection is complete and the assembly has cooled. The final NDT on a specific weld shall be performed at least 24 hours after the welding has been completed.
 17. Mark the welds, parts, and joints that have been inspected, and accepted, with a distinguishing mark or die stamp, or maintain records indicating the specific welds inspected and accepted by each inspector.
 18. Document the accepted and rejected items in a written report. Transmit the report to the designated recipients in a timely manner.
- D. Nondestructive Testing of Welded Joints
1. Magnetic Particle Testing: Magnetic Particle Testing (MT) shall be conducted by the District's Testing Agency at the frequency designated in Table 2-1. MT shall be performed in accordance with AWS D1.1, and D1.8.
 2. Ultrasonic Testing: Ultrasonic testing (UT) shall be conducted by the District's Testing Agency for the percentage of joints designated in Table 2-1. UT shall be performed in accordance with AWS D1.1.
 3. Weld Acceptance Criteria shall be in accordance with AWS D1.1. Regions of welds that cannot be inspected shall be identified and recorded, and the Structural Engineer shall be notified.
 4. K-Area Welding Inspection: After welds of continuity plates and doubler plates have cooled to ambient temperature, test column webs for cracking using liquid penetrant (PT) or magnetic particle testing (MT) over a zone 3" above and below each weld.
- E. Nondestructive Testing Requirements:

Weld Category	Complete Joint Penetration (1)	Partial Joint Penetration and Fillet Welds (2)
Welds not described below	No NDT required unless otherwise noted	No NDT required unless otherwise noted
SRLS welds not described below	MT 25% of joints, full length (2) UT 25% of joints, full length (2)	MT 25% of joints, 6" spot at random (2)
Top-flange joints at cantilever beam connections (3)	MT 100% of joints, full length UT 100% of joints, full length	MT 100% of joints, full length
Demand-Critical Welds; Butt joints in column splices	MT 100% of joints, full length UT 100% of joints, full length (4)	MT 100% of joints, full length

1. UT is required only when the weld thickness is 5/16" or greater.
2. If any joint fails testing, test 100% of joints until 40 consecutive welds pass. The testing rate may then be reduced to 25%.
3. Test joint on each side of cantilever beam support.
4. Reduce the rate of UT to 25% if after 40 welds have been inspected, an individual welder's reject rate is less than 5%.

- F. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at the following:
1. Identifiable components: Fastener assemblies with components found to be identifiable in accordance with Section 1 above shall be sampled as follows:
 - a. Projects requiring the installation of less than 1,600 fastener assemblies of a type of bolt: sample one complete fastener assembly for every 400 or fraction thereof for each type of bolt to be installed in the project, but not less than three complete fastener assemblies for each type of bolt to be installed in the project.
 - b. Projects requiring the installation of 1,600 or more fastener assemblies of a type of bolt: sample identifiable fastener assemblies at a rate of one per 1,200 (or fraction thereof) but not less than three complete fastener assemblies for each type of bolt to be installed in the project.
 2. Unidentifiable components: Fastener assemblies with components found to be unidentifiable in accordance with Section 1 above shall sample three complete fastener assemblies for every 100 or fraction thereof for each type of bolt to be installed in the project.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC S303 "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components and shear studs indicated on drawings.

- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Leveling of Column Base Plates: Contractor shall specify the means and methods for leveling the column base plates during erection. The leveling method shall have sufficient strength to support the imposed loads, including construction loading.
- H. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.04 CLEANING

- A. After erection, thoroughly clean surfaces of foreign or deleterious matter such as dirt, mud, oil, or grease that would impair bonding of fireproofing, concrete, or other finishes as applicable.

3.05 ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

- A. If temporary braces or erection clips are used, remove braces and clips in a manner which prevents unsightly surfaces.
- B. Tack welds shall be ground smooth.
- C. Holes shall be filled with weld filler metal or body solder and ground smooth.
- D. All operations shall be performed such that the close fit and neat appearance of the structure will not be impaired.
- E. Conform to AESS Specifications. See additional requirements in Section 05 12 13.

3.06 FIELD QUALITY CONTROL

- A. The District's Testing Agency will:
 1. Verify proper anchor rod group location, elevation, and orientation prior to placement of concrete foundations, and again subsequent to placement of concrete foundations prior to arrival of structural steel.
 2. Perform field welding inspection and testing in accordance with the requirements in Part 2 of this Specification for shop fabrication, unless otherwise noted.
 3. Inspect and test high strength bolted joints in accordance with RCSC and CBC Chapter 17A
 4. Sample and test bolt assemblies that include direct tension indicators, on a daily basis to verify proper indication of deformation with required bolt tension for each size and lot. The Inspector shall have a torque wrench, calibrated daily, to verify correlation with proper tension as installation proceeds. Test at least 10 percent of the bolts with a minimum of two per connection from the start of bolting and until waived by the DSA Field Engineer upon demonstration of continued good workmanship.
 5. Inspect erected structural steel as required to establish conformity of Work with reviewed shop drawings and Contract Drawings.
 6. Perform testing and inspection of welded stud connectors in accordance with requirements of AWS D1.1 and CBC Chapter 22A except that the test studs shall be subjected to a 90 degree bend test by striking them with a heavy hammer. After the bend test, the weld section shall not exhibit any tearing or cracking.

7. Inspect structural steel to verify that the Protected Zones of members of the Seismic-Load-Resisting System are free of damage and attachments not approved by the Structural Engineer.
8. Inspect braced frame connections prior to welding of braces to gusset plate to verify that the required clear width of gusset plate between the end of the brace and the diagonal stiffener plate, noted on the drawings as the "free plate zone", is maintained.
9. Forward copies of all test and inspection reports to the District, Architect, Structural Engineer, Contractor, and DSA.

END OF SECTION

SECTION 05 1213**ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).
 1. Requirements in Section 05 1200 - Structural Steel Framing also apply to AESS.

1.02 DEFINITIONS

- A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.
 1. AESS: Structural steel designated as "Architecturally Exposed Structural Steel" or "AESS" in the Contract Documents.
 2. Category AESS 1: Structural steel that is categorized by AISC 303, Section 10, as AESS 1 and may be designated AESS 1 or Category AESS 1 in the Contract Documents.
 3. Category AESS 2: Structural steel that is categorized by AISC 303, Section 10, as AESS 2 and is designated as AESS 2 or Category AESS 2 in the Contract Documents.
 4. Category AESS 3: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 3 and is designated as AESS 3 or Category AESS 3 in the Contract Documents.
 5. Category AESS 4: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 4 and is designated as AESS 4 or Category AESS 4 in the Contract Documents.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting at project site one week prior to start of work of this section; require attendance by all affected installers. Coordinate requirements for shipping, special handling, storage, attachment of safety cables and temporary erection bracing, final coating, touch-up painting, mock-up coordination, Architect's observations, and other requirements for AESS.
- B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.04 SUBMITTALS

- A. Action Submittals:
 1. Product Data:
 - a. Submit paint systems in accordance with Section 09 9600.
 - b. Tension-control, high-strength, bolt-nut-washer assemblies.
 - c. Corrosion-resisting (weathering steel), tension-control, high-strength, bolt-nut-washer assemblies.
 - d. Filler.
 - e. Primer.
 2. Shop Drawings: Detailing for fabrication of AESS components.
 - a. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
 - b. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
 - c. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.

- d. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
 - e. Indicate type, size, finish and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Indicate orientation of bolt heads.
 - f. Indicate which surfaces or edges are exposed and what class of surface preparation is being used.
 - g. Indicate special tolerances and erection requirements as noted on drawings or defined by the designated AESS category.
 - h. Indicate vent or drainage holes for HSS members.
3. AESS 3 and AESS 4 Samples: Provide samples of specific AESS characteristics. Samples may be small size samples or components of conventional structural steel demonstrating specific AESS characteristics, including surface preparation, sharp edges ground smooth, continuous weld appearance, weld show through, and fabrication mark removal.
4. Samples: Submit Samples of AESS to set quality standards for exposed welds.
- a. Two steel plates, 3/8 inch (9.53 mm) by 8 inches (203.20 mm) by 4 inches (101.6 mm), with long edges joined by a groove weld and with weld ground smooth.
 - b. Steel plate, 3/8 inch (9.53 mm) by 8 inches (203.20 mm) by 8 inches (203.20 mm), with one end of a short length of rectangular steel tube, 4 inches (101.6 mm) by 6 inches (150 mm) by 3/8 inch (9.53 mm), welded to plate with a continuous fillet weld and with weld ground smooth and blended.
- B. Informational Submittals:
- 1. Qualification data for fabricator and erector to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of architects and owners, photographs showing detail of installed AESS, and other information specified.

1.05 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements – CAL-Green, for the following measures:
 - 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.
- B. Erector Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- C. Comply with applicable provisions of AISC 303, Section 10 for the designated AESS category.

1.07 MOCK-UP

- A. Mockups: At least four weeks prior to fabricating AESS, construct mockups to demonstrate aesthetic effects as well as qualities of materials and execution.
- B. Review mockup during daylight hours.
- C. Provide mock-ups for AESS 3 and AESS 4 of nature and extent indicated in contract documents.

- D. Locate mock-ups in fabricator's shop. Mock-ups to be full-size unless Architect approves smaller models. Alternatively, when a mock-up is not practical, the first piece of an element or connection can be used to determine acceptability.
- E. Notify Architect one week in advance of dates and times when mock-ups will be available for review.
- F. Demonstrate applicable AESS characteristics for specified category of AESS on elements and joints in mock-up.
- G. Build mock-ups using member sizes and materials indicated for final work.
- H. Mock-up to demonstrate weld quality, contouring of welds at aligned walls of members, specified surface preparation, and finish coating.
- I. HSS members to extend at least 6 inches (152.4 mm) from joint in mock-up.
- J. Obtain Architect's written approval of mock-ups before starting fabrication.
- K. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging completed work.
- L. Approved mock-ups in an undisturbed condition at Date of Substantial Completion may not become part of completed work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

1.09 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Comply with Section 05 1200 - Structural Steel Framing, except as amended in this section for aesthetic purposes.
- B. Comply with AISC 303, Section 10 for specific AESS category designated on drawings.

2.02 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.03 STEEL

- A. Steel Members: As indicated in Section 05 1200 - Structural Steel Framing.

2.04 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Type 1, round head with matching compatible ASTM A563 nuts and ASTM F436/F436M washers.

1. Finish: Plain.

2.05 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.06 PRIMER

- A. Paint Maximum Product Emissions Limits: Primer paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District (SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.

1. CAL-Green Requirements for zinc rich primer coatings:
 - a. Zinc-Rich Primers: 340 grams per liter of product minus water.
 - b. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.

- B. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations specified in Section 01 8114.

- C. Zinc-Rich Primer: Shop applied.

1. Inorganic, zinc-rich, capable of providing sound foundation for field applied top coats despite prolonged exposure, cathodic protection and corrosion resistance. Similar to galvanizing.
2. Maximum Allowable Dry Time: 1 hour to touch; 12 hours to top coat.
3. Pigment Content: Minimum 63% zinc in dry film by weight.
4. Compatible with finish paint system specified in Section 09 9600 - High-Performance Coatings.
5. Product:
 - a. Tnemec Company, Inc.: 90-97 Tneme-Zinc, 2.5 to 3.5 mils total dry film thickness.

- D. Zinc-Rich Primer: Field applied.

1. Inorganic, zinc-rich, capable of providing sound foundation for field applied top coats despite prolonged exposure, cathodic protection and corrosion resistance. Similar to galvanizing.
2. Maximum Allowable Dry Time: 1 hour to touch; 12 hours to top coat.
3. Pigment Content: Minimum 63% zinc in dry film by weight.
4. Compatible with finish paint system specified in Section 09 9600 - High-Performance Coatings.
5. Product:
 - a. Tnemec Company, Inc.: 94H2O Hydro-Zinc, 2.5 to 3.5 mils total dry film thickness.

2.07 FABRICATION

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.

1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.

- C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.

- D. Bolted Connections:

1. Make in accordance with Section 05 1200 - Structural Steel Framing. Provide bolt type and finish as noted herein.

- E. Welded Connections:

1. Comply with AWS D1.1/D1.1M and Section 05 1200 - Structural Steel Framing.

2. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerances of this section.
- F. Surface Preparation:
1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 2. Remove backing and run out tabs.
- G. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
1. Category AESS 3:
 - a. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - b. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
 - c. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 - d. Make intermittent welds appear continuous, using filler or additional welding. Apply filler material over and between intermittent welds for a continuous, uniform, and smooth appearance. Verify filler material compatibility with coating system.
 - e. Seal weld open ends of hollow structural sections with 3/8 inch (9.53 mm) closure plates.
 - f. Limit butt and plug weld projections to 1/16 inch (1.58 mm).
 - g. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 - h. Remove weld spatter, slivers, and similar surface discontinuities.
 - i. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
 - j. Grind tack welds smooth unless incorporated into final welds.
 - k. Remove backing and runoff tabs, and grind welds smooth.
 - l. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
 - m. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
 - n. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
 - o. Conceal fabrication and erection markings from view in the completed structure.
 - p. Make welds uniform and smooth.
 - q. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
 - r. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
 - s. Orient HSS seams as indicated or away from view.
 - t. Align and match abutting member cross sections.
 - u. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
 - v. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.
 - w. In addition to the above requirements, provide the following:
 - 1) Treat HSS seams to appear seamless.
 - 2) Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.

2.08 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" using ASTM F3125/F3125M for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding the tolerance of this section.

2.09 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M, G100,
 - 1. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Location of Galvanized Steel: As indicated on Drawings.

2.10 PAINT SYSTEM

- A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Section 09 9600 - High Performance Coatings. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.

2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50.8 mm).
 - 2. Surfaces to be field welded.
- B. Surface Preparation:
 - 1. Provide surface preparations to meet SSPC-SP 6.
 - 2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
 - 3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
 - 4. Remove weld spatter, slivers and similar surface discontinuities.
 - 5. Ease sharp corners resulting from shearing, flame cutting or grinding.
- C. Priming - Interior Steel: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.12 GALVANIZING

- A. Hot-Dip Galvanized Finish - Exterior Steel: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

2.13 SOURCE QUALITY CONTROL

- A. Structural Requirements:

1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
- B. AESS 3 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on approved mock-up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Erector to check AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.
- B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

- A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
 2. Grind tack welds smooth.
 3. Remove backing and runoff tabs, and grind welds smooth.
 4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 5. Remove erection bolts in Category AESS 4 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
 6. Fill weld access holes in Category AESS 4 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
 7. Conceal fabrication and erection markings from view in the completed structure.
- B. AESS 3: Feature elements in close view:
1. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 2. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 3. Remove weld spatter, slivers, and similar surface discontinuities.
 4. Grind off butt and plug weld projections larger than 1/16 inch (1.5875 mm).
 5. Continuous welds shall be of uniform size and profile.
 6. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.

7. Splice members only where indicated on Drawings.
8. No torch cutting or field fabrication is permitted.
9. Weld profiles, quality, and finish shall be as approved by Architect.
10. Make joint welds, including tack welds, appear continuous by filling intermittent welds.
11. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
12. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- C. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.
- D. Structural Requirements:
 1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
 2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.
- E. AESS 3 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals as well as on approved mock-up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.06 CLEANING

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 9123 - Interior Painting and 09 9600 - High Performance Coatings .

3.07 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with field-applied zinc rich primer.
 1. Clean and prepare surfaces by SSPC-SP 6 power-tool cleaning.

END OF SECTION

SECTION 05 31 00
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Composite floor deck.
- B. Supplementary framing for openings up to and including 18 inches.
- C. Bearing plates and angles.
- D. Stud shear connectors.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete: Concrete topping over metal deck.
- C. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- D. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
- E. Section 05 50 00 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.03 REFERENCE STANDARDS

- A. California Code of Regulations, Title 24, Part 2, with DSA Amendments, also known as the California Building Code (CBC), 2019 Edition.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- E. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2013.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- J. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; ICC Evaluation Service, Inc; 2010 (R2013).
- K. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements; ICC Evaluation Service, Inc; 2013.
- L. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- D. Certificates: Certify that products furnished meet or exceed specified requirements.
- E. Submit manufacturer's installation instructions.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- G. Welding Procedures, WPQR if necessary.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this Section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 1. Verco Manufacturing Co. or equal product comply with ICC Report ER-1735P .
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STEEL DECK

- A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
- B. Composite Roof Deck: Fluted steel sheet embossed to interlock with concrete:
 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
- C. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
- B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
- C. Welding Materials: AWS D1.1/D1.1M.
- D. Fasteners: Galvanized hardened steel, self tapping.

- E. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
- F. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
- G. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

2.04 SOURCE QUALITY CONTROL

- A. The District's Testing Agency will:
 1. Review mill analysis and certificates of compliance.
 2. Test samples of unidentified steel as required by CBC

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 1-1/2 inch bearing.
- D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using welds.
 1. Welding: Use fusion welds through weld washers.
- E. Clinch lock seam side laps.
- F. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
- G. At welded male/female side laps weld at 18 inches on center maximum.
- H. Weld deck in accordance with AWS D1.3/D1.3M.
- I. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.
- J. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- K. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- L. Weld stud shear connectors through steel deck to structural members below.
- M. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

3.03 FIELD QUALITY CONTROL

- A. The District's Testing Agency will:
 1. Provide continuous inspection of welding, including prior fit-up, welding equipment, weld quality and welder certification per CBC.

2. Provide continuous inspection during installation as required to establish conformity of Work with requirements.

END OF SECTION

SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Formed steel stud exterior wall and interior wall framing.
- B. Exterior wall sheathing.
- C. Formed steel joist and purlin framing and bridging.
- D. Water-resistive barrier over sheathing.

1.02 RELATED REQUIREMENTS

- A. Section 07 21 00 - Thermal Insulation: Insulation within framing members.
- B. Section 07 25 00 - Weather Barriers: Weather barrier over sheathing.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Head and sill flashings.
- D. Section 07 92 00 - Joint Sealants.
- E. Section 09 21 16 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.
- F. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.
- G. Section 09 24 00 - Cement Plastering.
- H. Section 09 51 00 - Acoustical Ceilings: Ceiling suspension system.

1.03 REFERENCE STANDARDS

- A. California Code of Regulations, Title 24, Part II, 2019 Edition with DSA Amendments, also known as California Building Code (CBC).
- B. AISI S100-16 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- E. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2015.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a (Reapproved 2015).
- G. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- J. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc; 2013.
- K. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 - 1. Indicate stud and ceiling joist layout.
 - 2. Describe method for securing studs to tracks and for bolted framing connections.
- D. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.
- E. Weld Procedures if necessary.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing:
 - 1. CEMCO: www.cemcosteel.com.
 - 2. ClarkDietrich Building Systems;: www.clarkdietrich.com.
 - 3. The Steel Network, Inc: www.SteelNetwork.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Framing Connectors and Accessories:
 - 1. Same manufacturer as metal framing.
 - 2. ClarkDietrich Building Systems;: www.clarkdietrich.com.
 - 3. Simpson Strong Tie: www.strongtie.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Shop fabricate framing system to the greatest extent possible.
- C. Deliver to site in largest practical sections.

2.03 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gage and Depth: As indicated on the drawings.
 - 2. Products:
 - a. CST-SLP-TRK with horizontal slots by CEMCO per ESR 2012.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Joists and Purlins: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.
 - 1. Base Metal: Structural Steel (SS), Grade 33/230.
 - 2. Gage and Depth: As indicated on the drawings.
- C. Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
 - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 - 3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
 - 4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
 - 5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.
 - 6. Products:
 - a. TSN Driftclip DSLB per ESR 2049.

2.04 WALL SHEATHING

- A. Wall Sheathing: Gypsum; complying with requirements of ASTM C1396/C1396M for gypsum sheathing, V-shaped long edges, 5/8 inch Type X fire resistant.

2.05 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- C. Water-Resistive Barrier: As specified in Section 07 25 00.

2.06 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
 - 1. Products:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series: www.ITWBuildex.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Anchorage Devices: Powder actuated and Drilled expansion bolts.
- C. Welding: In conformance with AWS D1.1/D1.1M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method.
- C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- D. Install load bearing studs full length in one piece. Splicing of studs is not permitted.
- E. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
- F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- G. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- H. Attach cross studs to studs for attachment of fixtures anchored to walls.
- I. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- J. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF JOISTS AND PURLINS

- A. Install framing components in accordance with manufacturer's instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.

3.04 WALL SHEATHING

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

END OF SECTION

**SECTION 05 4300
SLOTTED CHANNEL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Slotted channel framing system.
- B. Accessories.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.03 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 3. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 4. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 5. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design slotted channel framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 1. Unistrut Corporation: www.unistrut.com.
 2. Prior approved equal.

2.02 MATERIALS

- A. General: Comply with regionally-sourced product requirements specified in Section 018114.
 1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- B. Slotted Channel Framing at Exterior: ASTM A653, Grade 33.
 1. Primary Framing Member Profile: 1-1/4 inch (30 mm); square, with holes on channel legs.
- C. Slotted Channel Framing at Interior: ASTM A1011, Grade 33.
 1. Primary Framing Member Profile: 1-1/4 inch (30 mm); square, with holes on channel legs.
- D. Slotted Channel Fittings: ASTM A1011/A1011M.
- E. Fasteners: As detailed or required for indicated applications; manufacturer's standard fasteners designed specifically for specified system.

- F. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
- G. Threaded Rod: ASTM A307; threaded full length of rod; minimum 1/2 inch diameter, or as required to suit design requirements.
- H. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District (SCAQMD) Rule No. 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type II - Organic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Fit and field assemble items in largest practical sections.
- B. Fabricate items with joints tightly fitted and secured.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- D. Supply components required for anchorage of framing components. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.
- D. After erection, repair and refinish abrasions.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) in 10 feet, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

**SECTION 05 5000
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - a. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- B. Informational Submittals:
 - 1. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
 - 2. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.03 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements- CAL-Green, for the following measures:
 - 1. 5.504.4.1 Adhesives and sealants.
 - 2. 5.504.4.3 Paints and coatings.
 - 3. 5.504.4.3.1 Aerosol paints and coatings.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.05 FIELD CONDITIONS

- A. If possible, design metal fabrications so that they do not have to fit other construction.
- B. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- B. Steel Sections: ASTM A36/A36M.
- C. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

- D. Plates: ASTM A283/A283M.
- E. Plates and Bars: ASTM A36/A36M.
- F. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed or electrolytic zinc-coated, ASTM A 879/A 879M, with steel sheet substrate complying with ASTM A 1008/A 1008M, commercial steel, exposed.
- G. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- K. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- L. Universal Primer:
 - 1. Manufacturer's standard, lead free primer, capable of providing sound foundation for field applied top coats despite prolonged exposure.
 - 2. Standard: FS TT-P-645.
 - 3. Compatible with finish paint system specified in Sections 09 9113 - Exterior Painting and 09 9123 - Interior Painting.
 - 4. Acceptable Products:
 - a. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66W310. Applied at a dry film thickness of not less than 3.0 mils.
 - b. Tnemec; Series 115 Uni-Bond DF. Applied at a dry film thickness of not less than 3.0 mils.
- M. Exposed Steel Primer:
 - 1. Zinc-Rich Primer:
 - a. Inorganic, zinc-rich, capable of providing sound foundation for field applied top coats despite prolonged exposure, cathodic protection and corrosion resistance.
 - b. Apply 2.5 to 3.5 mils DFT.
 - c. Maximum Allowable Dry Time: 1 hour to touch; 12 hours to top coat.
 - d. Pigment Content: Minimum 63% zinc in dry film by weight.
 - e. Compatible with finish paint system specified in Section 09 9600 - High-Performance Coatings.
 - f. Acceptable Products:
 - 1) Tnemec Co.; 90-97 Tneme-Zinc.

2.02 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Interior Aluminum Components: Type 304 stainless-steel fasteners.
 - 2. Exterior Aluminum Components: Type 316 stainless-steel fasteners.
 - 3. Interior Stainless-Steel Components: Type 304 stainless-steel fasteners.
 - 4. Exterior Stainless-Steel Components: Type 304 stainless-steel fasteners.
 - 5. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.

6. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 7. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads .
- C. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308.
1. Uses: Securing cold-formed steel framing to structure.
 2. Type: Torque-controlled expansion anchor or adhesive anchor.
 3. Material:
 - a. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
 4. Wedge Type:
 - a. Hilti Corp; KWIK BOLT 3, 1/4 inch (6.35 mm) to 1 inch (25 mm) diameter, ICC ESR-1385 and ESR-2302.
 - b. ITW Ramset; TRUBOLT WEDGE, 1/4 inch (6.35 mm) to 1-1/4 inch (31.75 mm) diameter, ICC ESR-3772.
 5. Sleeve Type:
 - a. DeWalt; Power-Bolt+ Heavy Duty Sleeve Anchor 1/4 inch (6.35 mm) to 3/4 inch (19.05 mm) diameter, ICC ESR-3260.
- D. Powder Actuated Fasteners
1. Use of Powder actuated fasteners for tension loads is limited to support of minor loads such as suspended acoustical ceilings, ductwork and conduit.
 2. Allowable Loads: Limited to less than 100 lbs.
 3. Permissible Loads:
 - a. Stone Aggregate Concrete: Minimum 0.177 inch diameter, minimum penetration 1-7/16 inch. Required Allowable Loads: 100 lbs. or 80 percent of values listed in ICC Report whichever is less.
 - 1) Hilti Corp; Low Velocity Powder-Actuated Fastners, ICC ERS-1663.
 - 2) ITW Ramset; 3300 SERIES, ICC ESR-1799.
- E. Bolts, Nuts and Washers
1. Bolts: ASTM A307, hex head.
 2. Nuts: ASTM A563, hex head.
 3. Washers: FS FF-W-92, helical spring.
 4. Plain Washers, ASTM F436, Type 1.
 5. Beveled Washers, ASTM F436, Type 1.
 6. High strength bolts, ASTM F3125/F3125M.
 7. Lag screws and lag bolts: ANSI B18.2.1; hex head.
 - a. Galvanizing for Bolts and Nuts: ASTM A153/A153M; galvanizing required for exterior applications.
 8. Nelson Studs: Use header anchors sized as shown on the drawings.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Provide and install items listed in schedule and shown on Drawings with anchorage and attachments necessary for installation.
- B. The following is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
 - 1. Slotted Channel Framing System: Specified in Section 05 4300 - Slotted Channel Framing.
 - 2. Countertop Supports: 2x 2inch square steel tube, as detailed, prime paint finish.

2.05 ACCESSORIES

- A. Non-Shrink Grout: ASTM C1107/C1107M, Grade B; pre-mixed compound consisting of non-metallic aggregate, cement, and manufacturer's specified water reducing and plasticizing agents; non-staining, non-gas-forming, containing no chlorides; plastic consistency as measured according to ASTM C230/C230M; capable of developing minimum compressive strength of 7,000 psi in 28 days.

2.06 ELEVATORS

- A. Hoist Beam:
 - 1. Provide elevator equipment hoist beams required for elevator installation capable of supporting minimum 20,000 pound load.
 - 2. Provide elevator hoistway divider beams required for the support of cab and counter weight rails.
 - 3. Finish: Prime.
- B. Sill Support: Provide threshold support
- C. Guide Rails: Provide intermediate guide rail supports sized and spaced as required by code and elevator manufacturer for guide rails spanning more than 14 feet between supports.
- D. Sump Grating
 - 1. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 1 inch (25 mm) in least dimension.
- E. Provide steel angle supports as indicated.

2.07 METAL BOLLARDS

- A. Fabricate exterior and interior metal bollards from 4 inch (102 mm) diameter Schedule 40 steel pipe.
 - 1. Concrete filled, crowned cap.
 - 2. Exterior Bollards in Slab on Grade: Penetration depth below top of slab to equal detailed height; core hole in slab on grade 2 inches (51 mm) inches larger than bollard diameter, and fill joint at slab with a non-shrink grout; prime paint finish.
- B. Prime steel bollards with zinc-rich primer.
- C. Finish Paint: As indicated in Section 09 9113 - Exterior Painting.
 - 1. Color: Paint OSHA Safety Yellow or as specified by Owner requirements.

2.08 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Prime loose steel lintels located in exterior walls with universal primer.

2.09 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES - STEEL

- A. General:
 - 1. Prepare surfaces to be primed in accordance with SSPC-SP6, or as recommended by finish coating manufacturer.
 - 2. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Prime paint steel items, unless otherwise specified.
 - 1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
 - 2. Prepare surfaces to be primed in accordance with SSPC-SP6, or as recommended by finish coating manufacturer.
 - 3. Prime Painting: Zinc-rich primer, one coat.
 - 4. Finish Paint: Finish paint in accordance with Section 09 9600 - High-Performance Coatings.

2.11 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on Drawings.
- D. Obtain approval prior to site cutting or making adjustments not scheduled.

- E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.05 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2 mil (0.05 mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 9113 - Exterior Painting, Section 09 9123 - Interior Painting, and Section 09 9600 - High Performance Coatings.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 5100

METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stairs with metal treads.
- B. Structural steel stair framing and supports.
- C. Design engineering for stair assemblies.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - a. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - b. Include the design engineer's seal and signature on each sheet of shop drawings.
- B. Informational Submittals:
 - 1. Welders' Certificates: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
 - 2. Welders' Certificates.
 - 3. Designer's Qualification Statement.
 - 4. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 5.504.4.1 Adhesives and sealants.
 - 2. 5.504.4.3 Paints and coatings.
 - 3. 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 6. Section A5.405.5: Provide documentation that cement and concrete used are made with recycled content and/or alternative energy.

1.04 QUALITY ASSURANCE

- A. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- B. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
 - 3. A company specializing in manufacturing products specified in this Section, with not less than ten years of documented experience.

- C. Certifications:
 1. Submit certificates verifying AWS qualifications for each welder employed on Project.
 2. Submit fabricator's certification that products furnished for Project meet or exceed specified requirements.
- D. Certification that fabrication and installation comply with structural requirements listed this Section.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
 3. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.
 - a. Stair Capacity: Uniform live load of 100 lb/sq ft (4.7 kPa) and a concentrated load of 300 lb (14.4 kg) with deflection of stringer or landing framing not to exceed 1/240 of span.
 4. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Component Importance Factor: 1.5.
 5. Dimensions: As indicated on Drawings.
 6. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 7. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 8. Separate dissimilar metals using paint or permanent tape.
 9. Interior stairs shall have the upper approach and lower tread marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
 10. The stripe providing clear visual contrast shall be a minimum of 2 inches (50.8 mm) wide to a maximum of 4 inch (101.6 mm) wide placed parallel to, and not more than 1 inch (25 mm) from tile nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
 11. The radius of curvature at the leading edge of the tread shall be no greater than 1/2 inch (12.70 mm). Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. The maximum angle for a riser to slope under the tread shall be 30 degrees from vertical. Nosings shall extend 1-1/4 inch (31.75 mm) maximum over the tread below.
 12. Treads shall be 11 inches (279.40 mm) deep minimum. Risers shall be 7 inches (177.80 mm) high maximum and 4 inches (101.6 mm) high minimum. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.
- B. Metal Jointing and Finish Quality Levels:
 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.

- c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
 - D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH METAL TREADS

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Checkered steel plate.
 - 1. Tread Thickness: 1/8 inch (6 mm), minimum.
 - 2. Nosing: Plate bent to minimum radius with down return of 1 inch (25 mm).
 - 3. Anchorage to Stringers: Welded to carrier angles welded or bolted to stringers.
- D. Risers: Steel sheet.
 - 1. Riser Thickness: As required by design; 1/8 inch (6 mm) minimum.
 - 2. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
- E. Stringers: Rolled steel channels.
 - 1. Stringer Depth: As indicated on Drawings, 10 inches (250 mm), minimum.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Finish: Shop- or factory-prime painted.

2.03 MATERIALS

- A. General: Comply with recycled content product requirements specified in Section 01 8114.
- B. Steel Sections: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- D. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
- E. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- F. Checkered Plate: ASTM A786/A786M, rolled steel floor plate; manufacturer's standard pattern.

2.04 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A 563M); and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308.
1. Uses: Securing cold-formed steel framing to structure.
 2. Type: Torque-controlled expansion anchor or adhesive anchor.
 3. Material:
 - a. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
 4. Wedge Type:
 - a. Hilti Corp; KWIK BOLT 3, 1/4 inch (6.35 mm) to 1 inch (25 mm) diameter, ICC ESR-1385 and ESR-2302.
 - b. ITW Ramset; TRUBOLT WEDGE, 1/4 inch (6.35 mm) to 1-1/4 inch (31.75 mm) diameter, ICC ESR-3772.
 5. Sleeve Type:
 - a. DeWalt; Power-Bolt+ Heavy Duty Sleeve Anchor 1/4 inch (6.35 mm) to 3/4 inch (19.05 mm) diameter, ICC ESR-3260.

2.05 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- B. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- C. Steel Bolts, Nuts, and Washers: Galvanized to ASTM A153/A153M where connecting galvanized components.
- D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- E. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water
- F. Universal Primer:
 1. Manufacturer's standard, lead free primer, capable of providing sound foundation for field applied top coats despite prolonged exposure.
 2. Standard: FS TT-P-645.
 3. Compatible with finish paint system specified in Section 099113.
 4. Location: Interior stairs.
 5. Acceptable Products:
 - a. Dunn-Edwards Corporation; BRPR00-1 Bloc-Rust Premium, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer.
 - b. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66W310.
 - c. Tnemec; Series 115 Uni-Bond DF.

2.06 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.

- B. Assemble stairs in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (0.79 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Delete first subparagraph below if appearance is not important or if economy is more important.
 - 5. Weld exposed corners and seams continuously unless otherwise indicated.
 - 6. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 - 2. Locate joints where least conspicuous.
 - 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 - 4. Provide weep holes where water may accumulate internally.

2.07 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Fabricate stringers of steel channels as indicated on Drawings.
 - a. Stringer Size: As indicated on Drawings.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 - 2. Construct platforms of steel steel tube headers and miscellaneous framing members as indicated on Drawings.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Shop primed.
 - 3. Weld stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 - 4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
 - 1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 - 2. Steel Sheet: Galvanized-steel sheet.

3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 4. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.
- D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.097 inch (2.5 mm).
1. Steel Sheet: Uncoated, hot-rolled steel sheet unless otherwise indicated.
 2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
 3. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
 4. Weld steel supporting brackets to stringers and weld treads to brackets.
 5. Fabricate platforms with integral nosings matching treads and weld to platform framing.
 6. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
 7. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
 8. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.

2.08 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M, G80.
 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.
 2. Galvanize exterior stairs and as indicated on Drawings.
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete with setting templates.

3.03 INSTALLATION - GENERAL

- A. Install components plumb and level, accurately fitted, free from distortion or defects.

- B. Provide anchors, plates and angles required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on Drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 INSTALLING METAL STAIRS WITH METAL TREADS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
 - 1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.
 - a. Clean bottom surface of baseplates.
 - b. Set steel stair baseplates on wedges, shims, or leveling nuts.
 - c. After stairs have been positioned and aligned, tighten anchor bolts.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

3.06 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

END OF SECTION

SECTION 05 5133

METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop-fabricated metal ladders.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide manufacturer's data sheets on each ladder safety system product to be used, including installation instructions.
 2. Shop Drawings:
 - a. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - b. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- B. Informational Submittals:
 1. Certificate: Provide documentation that ladder safety system products of this section meet or exceed cited 29 CFR 1910.28, 29 CFR 1910.29, ANSI/ASSP Z359.16, and ANSI A14.3 requirements.
 2. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
 3. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements- CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 6. Section A5.405.5: Provide documentation that cement and concrete used are made with recycled content and/or alternative energy.

1.04 WARRANTY

- A. Warranty: Manufacturer's standard five year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Plates: ASTM A283/A283M.

- C. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Bolts, Nuts, and Washers: ASTM A307, plain.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED LADDERS

- A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
 1. Side Rails: 3/8 by 2 inches (9 by 50 mm) members spaced at 20 inches (500 mm).
 2. Rungs: One inch (25 mm) diameter solid round bar spaced 12 inches (300 mm) on center.
 3. Space rungs 7 inches (175 mm) from wall surface.

2.04 FINISHES - STEEL

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Prime Painting: One coat.

2.05 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Confirm that the ladder structure to which the ladder safety system is installed is capable of withstanding the loads applied by the system in the event of a fall.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.

- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

**SECTION 05 5213
PIPE AND TUBE RAILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings at steps.
- D. Structural design of railing systems.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - a. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - b. Include the design engineer's seal and signature on each sheet of shop drawings.
 - 2. Samples: Submit two, 12 inch (305 mm) long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.
 - 3. Fabricator's Qualification Statement.
- B. Informational Submittals:
 - 1. Welders' Certificates: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
 - 2. Welders' Certificates.
 - 3. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.
 - 4. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.03 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.

1.04 QUALITY ASSURANCE

- A. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- B. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

1.05 MOCK-UPS

- A. Mock-Ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mock-ups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (610 mm) in length.
 2. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 PRODUCTS**2.01 PERFORMANCE REQUIREMENTS**

- A. Design and fabricate railing and handrails in accordance with California Building Code 11B-505.
1. Top of gripping surfaces of handrails shall be 34 inches (863.60 mm) minimum and 38 inches (965.20 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
 2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2 inches (38 mm) minimum. Handrail may be located in a recess if the recess is 3 inches (76.20 mm) maximum deep and 18 inches (457.20 mm) minimum clear above the top of the handrail.
 3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1-1/2 inches (38 mm) minimum below the bottom of the handrail gripping surfaces.
 4. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4 inches (31.75 mm) minimum and 2 inch (50.8 mm) maximum.
 5. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4 inches (101.60 mm) minimum and 6-1/4 inches (158.75 mm) maximum, and a cross-sectional dimension of 2-1/4 inches (57.15 mm) maximum.
 6. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
 7. Handrails shall not rotate within their fittings.
 8. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
 9. A 2 inch (50.8 mm) minimum high curb or barrier shall be provided to prevent the passage of a 4 inches (101.60 mm) diameter sphere, where any portion of the sphere is within 4 inches (101.60 mm) of the finish floor or ground surface. Such a curb or a barrier shall be continuous and uninterrupted along the length of a ramp. CBC Section 11B-405.9.2.
- B. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

- D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
- E. Allow for expansion and contraction of members and building movement without damage to connections or members.
- F. Dimensions: Refer to Drawings for configurations and heights.
- G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 - 2. For anchorage to stud walls, provide backing plates, for bolting anchors.
 - 3. Posts: Provide adjustable flanged brackets.
- H. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- I. Allow for expansion and contraction of members and building movement without damage to connections or members.
- J. Dimensions: Refer to drawings for configurations and heights.
 - 1. Top Rails and Wall Rails: 1-1/2 inches (38 mm) diameter, round.
 - 2. Posts: 1-1/2 inches (38 mm) diameter, round.
- K. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

2.02 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- E. Interior Railings: Prime painted.
 - 1. 1-1/2 inch (38 mm) diameter posts, top rail and handrail with 1/2 inch (12.70 mm) square vertical pickets.

2.03 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.04 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District (SCAQMD) Rule No. 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.05 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured.
- D. Welded Joints:
 1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 2. Interior Components: Continuously seal joined pieces by continuous welds.
 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

2.06 STEEL AND IRON FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.
 2. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - a. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 - b. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
- D. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- E. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- F. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- G. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- H. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards and the California Building Code for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
- F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.05 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.06 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

**SECTION 05 7011
DECORATIVE METAL STAIRS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative stairs.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this Section.
 - 1. Attendees shall include, but not be limited to:
 - a. Contractor.
 - b. Manufacturer's representative.
 - c. Architect.
 - d. Owner's representative.
 - e. Other subcontractors of adjacent work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - a. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - b. Include the design engineer's seal and signature on each sheet of shop drawings.
 - 2. Samples: Submit three of each item below for each type and condition shown.
- B. Informational Submittals:
 - 1. Welders' Certificates: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
 - 2. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing decorative stairs and railing systems and acceptable to manufacturer.
- B. Templates: Supply installation templates, reinforcing and required anchorage devices.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.

- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover, in a dry location.

PART 2 PRODUCTS

2.01 METAL STAIRS

- A. Decorative Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 - 1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
 - 2. Structural Design: Provide complete stair and railing assemblies complying with the following:
 - a. Stair Capacity:
 - 1) Live Load: Uniform live load of 100 lb/sq ft (4.7 kPa) and a maximum concentrated load of 300 lb (136 kg) with deflection of stringer or landing framing not to exceed 1/360 of span.
 - 2) Dead Load: Weight of stair, associated railing system, any concrete fill, cladding and other finishes.
 - 3) Deflection Limits: Deflection of stringer or landing framing not to exceed 1/360 of span.
 - b. Railing Assemblies: See "Railing Systems" below. Comply with ASTM E985.
 - 3. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Component Importance Factor: 1.5.
 - 4. Dimensions: As indicated on Drawings.
 - 5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 - 6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 - 7. Separate dissimilar metals using paint or permanent tape.
 - 8. Interior stairs shall have the upper approach and lower tread marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
 - 9. The stripe providing clear visual contrast shall be a minimum of 2 inches wide to a maximum of 4 inches wide placed parallel to, and not more than 1 inch from tile nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
 - 10. The radius of curvature at the leading edge of the tread shall be no greater than 1/2 inch. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. The maximum angle for a riser to slope under the tread shall be 30 degrees from vertical. Nosings shall extend 1-1/4 inches maximum over the tread below.
 - 11. Treads shall be 11 inches deep minimum. Risers shall be 7 inches high maximum and 4 inches high minimum. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.
- B. Metal Jointing and Finish Quality Levels:
 - 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.

- d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
 - 1. Concrete Depth: 1-1/8 inches (28.57 mm), minimum.
 - 2. Terrazzo: Provide 3/8 inch (9.53 mm) thick terrazzo in accordance with Section 09 6623 - Resinous Matrix Terrazzo Flooring.
 - 3. Tread Pan Material: Steel sheet.
 - 4. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch (1.9 mm) minimum.
 - 5. Concrete Reinforcement: Welded wire mesh.
 - 6. Concrete Finish: Steel troweled.
- D. Finish Risers: Integral with treads.
 - 1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius, as indicated on Drawings.
 - 2. Nosing Depth: Not more than 1 inch (25.4 mm) overhang.
- E. Stringers: Steel tube.
 - 1. Stringer Depth: As indicated on drawings, minimum.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Tread and Riser Finish Material: Precast terrazzo as indicated in Section 09 6623 - Resinous Matrix Terrazzo Flooring.

2.03 MATERIALS

- A. Steel Components:
 - 1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
 - 2. Tubing: 1 structural tubing, round and shapes as indicated.
 - 3. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - a. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 4. Welding Materials: 1; type required for materials being welded.

2.04 ACCESSORIES

- A. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal railings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- B. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District (SCAQMD) Rule No. 1113 and Cal-GREEN Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. Cal-GREEN Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
- D. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
 - 2. For anchorage to masonry, provide brackets to be embedded in masonry for bolting anchors.
 - 3. For anchorage to stud walls, provide backing plates for bolting anchors.
- E. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch (0.4 mm) dry film thickness per coat.
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Manufacturer's standard, lead free primer, capable of providing sound foundation for field applied top coats despite prolonged exposure.
 - 2. Standard: FS TT-P-645.
 - 3. Compatible with finish paint system specified in Sections 099113 and 099123.
 - 4. Acceptable Products:
 - a. Dunn-Edwards Corporation; BRPR00-1 Bloc-Rust Premium, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer.
 - b. Glidden Professional; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer.
 - c. BRPR00-1 Bloc-Rust Premium, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer, Dunn-Edwards Corporation.
 - d. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66W310.
 - e. Tnemec; Series 115 Uni-Bond DF.
 - 5. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

2.05 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (0.79 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Delete first subparagraph below if appearance is not important or if economy is more important.
 5. Weld exposed corners and seams continuously unless otherwise indicated.
 6. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 2. Locate joints where least conspicuous.
 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 4. Provide weep holes where water may accumulate internally.

2.06 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.
- B. Stair Framing:
1. Steel plate stringers are less expensive than channels or rectangular tubes, except for longer spans, and allow railing posts to be welded to face of stringer. Allowing plates, channels, or rectangular tubes gives fabricator maximum flexibility.
 2. Fabricate stringers of steel channels as indicated on Drawings.
 - a. Stringer Size: As indicated on Drawings.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Galvanized and shop primed.
 3. Construct platforms of steel channel headers and miscellaneous framing members as indicated on Drawings.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Galvanized and shop primed.
 4. Weld stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 5. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
 6. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 2. Steel Sheet: Uncoated, cold-rolled steel sheet unless otherwise indicated.
 3. Steel Sheet: Galvanized-steel sheet.
 4. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 5. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

- a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.07 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.08 STEEL AND IRON FINISHES

- A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Stairs Indicated to Receive Universal Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Other Railings: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated stairs with universal shop primer indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

- A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
- B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 1. Coat concealed surfaces of [aluminum] [and] [copper alloys] that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction

3.04 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Weld connections that cannot be shop welded due to size limitations.
 1. Weld in accordance with 1.
 2. Match shop welding and bolting.
 3. Clean welds, bolted connections and abraded areas.
 4. Touch up shop primer and factory applied finishes.
 5. Repair galvanizing with galvanizing repair paint per 1.
- F. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.05 INSTALLING METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

- E. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 03 3000 - Cast-in-Place Concrete.
 - 1. Install abrasive nosings with anchors fully embedded in concrete.
 - 2. Center nosings on tread width.
- G. Install terrazzo in accordance with Section 09 6623 - Resinous Matrix Terrazzo Flooring.

3.06 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.07 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.08 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
 - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

**SECTION 05 7013
DECORATIVE METAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative metal screening panels.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section.
 - 1. Attendees shall include, but not be limited to:
 - a. Contractor.
 - b. Architect.
 - c. Owner's representative.
 - d. Other subcontractors of adjacent work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
 - 2. Shop Drawings: Indicate system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
 - 3. Samples: Submit three of each item below for each type and condition shown.
 - a. Each type of exposed metal: 12 inch by 12 inch (305 mm by 305 mm), illustrating color, thickness and edge condition.
- B. Informational Submittals:
 - 1. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing decorative metal and acceptable to manufacturer.
- B. Templates: Supply installation templates, reinforcing and required anchorage devices.

1.06 MOCK-UP

- A. Mock-Ups: Construct an example of each item specified. Locate mock-ups where directed. Mock-ups may remain as part of the work.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover, in a dry location.

1.08 FIELD CONDITIONS

- A. Do not install decorative metal until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).
- B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

PART 2 PRODUCTS

2.01 SCREE WALL PANELS

- A. Perforated screens including metals for complete system as indicated on Drawings.

2.02 MATERIALS

- A. Refer to Finish Schedule for selected products and finishes.
- B. General:
 - 1. Provide architecturally exposed metals free from surface blemishes in finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
 - 2. Provide architectural grade steel where exposed to view.
- C. Aluminum Components:
 - 1. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, 0.125 inch thick.
 - 2. Extruded Bar and Shape: ASTM B221, 6063-T6
 - 3. Extruded Pipe and Tube: ASTM B429, 6063-T6
 - 4. Sheet: ASTM B209, 3003 or 5005, thickness as required for purposed intended.
 - a. Expanded flattened metal.
 - 5. Perforated Aluminum Plate: ASTM B209, Alloy 3003 or 5005, 0.125 inch thick with 1/4 inch (6.35 mm) holes 1/2 inch (12.70 mm) o.c.
- D. Steel Components:
 - 1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
 - 2. Tubing: ASTM A501/A501M structural tubing, round and shapes as indicated.
 - 3. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
 - 4. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.03 ACCESSORIES

- A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of panel.
- B. Universal Primer:

1. Manufacturer's standard, lead free primer, capable of providing sound foundation for field applied top coats despite prolonged exposure.
 2. Standard: FS TT-P-645.
 3. Compatible with finish paint system specified in Sections 099113 and 099123.
 4. Acceptable Products:
 - a. Dunn-Edwards Corporation; BRPR00-1 Bloc-Rust Premium, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer.
 - b. Glidden Professional; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer.
 - c. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66W310.
 - d. Tnemec; Series 115 Uni-Bond DF.
- C. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch (0.4 mm) dry film thickness per coat.
- D. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for color match, strength, and compatibility in fabricated items.

2.04 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Exterior Aluminum Components: Type 316 stainless-steel fasteners.
 2. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 3. Dissimilar Metals: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads .
- C. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 .
1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.05 FABRICATION

- A. General:
1. Form decorative metalwork to required shapes and sizes, with true curves, lines, and angles.
 2. Provide components in sizes and profiles indicated, but not less than required to comply with requirements for structural performance.
 3. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
 4. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
 5. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
 6. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (0.79 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces
 7. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work.
 - a. Drill and tap for required fasteners.
 - b. Use concealed fasteners wherever possible.

8. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.
 - a. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.
 9. Joints:
 - a. Mill joints to tight, hairline fit.
 - b. Cope or miter corner joints.
 - c. Form joints exposed to weather to exclude water penetration.
 10. Provide castings sound and free of warp, cracks, blow holes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gatemarks, casting flash, and other casting marks.
 11. Finish exposed surfaces to smooth, sharp, well-defined lines and arrises.
 12. Assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Sheet Metal Work:
1. Provide materials selected for their surface flatness, smoothness and freedom from surface blemishes where exposed to view in the finished unit.
 2. Do not use materials having exposed-to-view surfaces exhibiting pitting, seam marks, roller marks "oil canning", stains, discoloration or other imperfections.
 3. Sheet Steel: Commercial quality cold-rolled carbon steel sheet as follows, unless otherwise indicated:
 - a. Sheet Steel: ASTM A1008/A1008M, Class I, matte finish.
 4. Provide Phillips flat-head or hex-head machine screws for exposed fasteners.
 5. Form sheet metal items in maximum lengths with minimum joints.
 6. Do not expose cut edges of sheet metal.
 7. Fold back exposed ends of unsupported sheet metal to form 1/2 inch wide hem of concealed side or ease exposed edges with backing to radius of approximately 1/32 inch.
 8. Form items with flat, flush surfaces, true to line and level, without cracking or grain separation at bends.
 9. Install with fastener patterns indicated.
- C. Shop Assembly: Preassemble items in shop to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
1. Fasteners and Connections: Concealed.
 2. Exterior Joints: Weathertight.
 3. Formed or Bent Corners: 1/4 inch minimum radius.
 4. Clips, Braces, and Miscellaneous Attachments: Hot-dip galvanized steel or aluminum.

2.06 FINISHES

- A. Finishes, General: Comply with NAAMM 500-06.
1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions and surface blemishes to match sheet.
 2. Protect mechanical finishes on exposed surfaces from damage.
 3. Finish: Mill.
- B. Aluminum Finishes:
1. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

- A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
- B. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions, and directions for installing items having integral anchors that are to be embedded in concrete or masonry construction.
- C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
- C. Provide anchorage devices and fasteners where necessary for securing decorative metal items to in place construction.
 - 1. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Perform cutting, drilling, and fitting required to install decorative metalwork.
- F. Set products accurately in location, alignment, and elevation, plumb, level, and true, measured from established lines and levels.
- G. Fit exposed connections to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.
- H. Restore finishes to eliminate evidence of cutting, welding, and grinding.
- I. Do not cut or abrade finishes that cannot be completely restored in field. Return such items to shop for required alterations, followed by complete refinishing, or provide new units.
- J. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses, to make work weatherproof, soundproof, or lightproof where necessary for proper performance.
- K. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations.
 - 2. Grind exposed welded joints smooth and restore finish to match finish of adjacent surfaces.

- L. Weld connections that cannot be shop welded due to size limitations.
 - 1. Weld in accordance with AWS D1.1/D1.1M.
 - 2. Match shop welding and bolting.
 - 3. Clean welds, bolted connections and abraded areas.
- M. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/16 inch (1.58 mm) per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/16 inch (1.58 mm).

3.05 ADJUSTING

- A. Touchup Finishing: Immediately after erection, clean abraded areas and refinish to match adjacent exposed areas with same material.

3.06 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

3.07 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
 - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

**SECTION 05 7300
DECORATIVE METAL RAILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Railing and guardrail assemblies.
- B. Design engineering of railing systems.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Review and coordinate setting drawings, shop drawings, templates, and instructions for installation of related items to be embedded in concrete and masonry.
- B. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this Section.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Require attendance by the following:
 - a. Contractor.
 - b. Manufacturer's representative.
 - c. Architect.
 - d. Owner's representative.
 - e. Other subcontractors of adjacent work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, infill, anchors, and accessories.
 - 2. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
 - 3. Samples for Verification: For each type of exposed finish required.
 - a. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - b. Fittings and brackets.
 - c. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- B. Informational Submittals:
 - 1. Manufacturer's Certification: Certify that railings have been designed to meet the design criteria of the specified code; include all conditions or limitations of the design necessary to achieve the necessary strength for the loading specified.
 - 2. Manufacturer's Installation Instructions.
 - 3. Maintenance Data: Manufacturer's instructions for care and cleaning.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing glazed railing systems and acceptable to manufacturer.

1.05 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000 - Quality Requirements.
- B. Mock-up: Construct a railing of each type specified.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver railing materials in factory provided protective coverings and packaging.
- B. Protect railing materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect railing materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover, in a dry location.

1.07 FIELD CONDITIONS

- A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).
- B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Metal and Glass Materials - General: Comply with recycled content product requirements specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green.
- B. Railings - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
 - 1. Design Criteria: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
 - a. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot (730 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
 - b. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
 - c. Allow for expansion and contraction of members and building movement without damage to connections or members.
 - d. Concentrated Loads on Intermediate Rails: 50 pounds per square ft (0.22 per sq m), minimum.
 - 2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
 - 3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
 - 4. Field Connections: Provide sleeves to accommodate site assembly and installation.
 - 5. Welded and Brazed Joints: Make exposed joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
 - a. Ease exposed edges to small uniform radius.

- b. Welded Joints:
 - 1) Carbon Steel: Perform welding in accordance with AWS D 1.1/D1.1M.
 - 2) Stainless Steel: Perform welding in accordance with AWS D 1.6.

2.02 RAILING SYSTEMS

- A. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- B. Post Railing System: Engineered, post supported railing system with metal grating infill panels.
 - 1. Configuration and Size: As indicated on Drawings.
 - 2. Handrail: Stainless steel tube, 1-1/2 inch diameter by 0.145 inch wall thickness.
 - 3. Handrail Brackets:
 - a. Same metal as railing.

2.03 MATERIALS

- A. Stainless Steel Components:
 - 1. Pipe: ASTM A 312/A 312M, Grade TP 304.
- B. Steel Components:
 - 1. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
 - 2. Plates and Shapes: ASTM A36/A36M.
 - 3. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.
 - 4. Welded Steel Grating:
 - a. Bearing Bar Spacing:
 - b. Bar Size: 1-1/2 inches (38 mm) by 3/16 inch (5 mm).
 - c. Bar Spacing: 11/16 inch (17.46 mm)
 - d. Surface: Plain.
 - e. Basis of Design Product:
 - 1) McNichols Co., Inc.; CMW-4-150.
 - 2) Prior approved equal.
 - 5. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

2.04 ACCESSORIES

- A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
 - 2. For anchorage to stud walls, provide backing plates for bolting anchors.
- B. Hydraulic Expansion Cement: ASTM C1107/C1107M.
- C. Sealant: As specified in Section 07 9200 - Joint Sealants.

2.05 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
 - 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 2. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
 - 3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A 563M); and, where indicated, flat washers.
- D. ICC-ES AC193 is for mechanical anchors and ICC-ES AC308 is for adhesive anchors.
- E. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Type: Torque-controlled expansion anchor or adhesive anchor.
 - 3. Material:
 - a. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
 - 4. Wedge Type:
 - a. Hilti Corp; KWIK BOLT II, 1/4 inch (6.35 mm) to 1 inch (25 mm) diameter, ICC ESR-1385 and ESR-2302.
 - b. ITW Ramset; TRUBOLT WEDGE, 1/4 inch (6.35 mm) to 1-1/4 inch (31.75 mm) diameter, ICC ESR-3772.
 - 5. Sleeve Type:
 - a. ITW Ramset; DYNABOLT SLEEVE, 1/4 inch (6.35 mm) to 3/4 inch (19.05 mm) diameter, California State Fire Marshall..
 - 6. Shell Type:
 - a. Hilti Corp; SERIES HDI, 1/4 inch (6.35 mm) to 1 inch (25 mm) diameter, ICC ESR-4236.
 - b. ITW Ramset; MULTI-SET II, 1/32 inch (0.79 mm) to 3/4 inch (19.05 mm) diameter, LA RR2748, California State Fire Marshall.

2.06 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
 - 1. Basis of Design Product:
 - a. Cloverdale; ClovaClean
 - b. Krud Kutter; Metal Clean and Etch.
 - c. Great Lakes Laboratories; Clean'n Etch.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.07 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for

reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.
- H. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- I. Form changes in direction as follows:
 - 1. As detailed.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.08 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.09 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.

- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.10 STEEL FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 3, Power Tool Cleaning.
 - 2. Number of Coats: One.
 - 3. Interior Railings: Universal primer.
- D. Exterior Railings: Galvanized.
- E. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M, G80.
 - 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.
 - 2. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - a. Comply with ASTM A123/A123M, Grade 100 for hot-dip galvanized railings.
 - b. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
- F. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- G. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- H. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- I. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- J. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- K. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
- L. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

- A. Protect existing work.
- B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
- C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.05 FIELD QUALITY CONTROL

- A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.07 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
 - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 05 7313
GLAZED DECORATIVE METAL RAILINGS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Glazed decorative railings and guardrail assemblies.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Review and coordinate setting drawings, shop drawings, templates, and instructions for installation of related items to be embedded in concrete and masonry.
- B. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this Section.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Attendees shall include, but not be limited to:
 - a. Contractor.
 - b. Manufacturer's representative.
 - c. Architect.
 - d. Owner's representative.
 - e. Other subcontractors of adjacent work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
 - 2. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
 - 3. Samples: Submit three of each item below for each type and condition shown.
 - a. Glass: 12 inch by 12 inch (305 mm by 305 mm), illustrating color, thickness and edge condition.
 - b. Railing: 12 inch (305 mm) long section of handrail illustrating color, finish and connection detail.
- B. Informational Submittals:
 - 1. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
 - 2. Manufacturer's Installation Instructions.
 - 3. Maintenance Data: Manufacturer's instructions for care and cleaning.
 - 4. Manufacturer's Certification: Certify that railings have been designed to meet the design criteria of the specified code; include all conditions or limitations of the design necessary to achieve the necessary strength for the loading specified.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 5.504.4.1 Adhesives and sealants.
 - 2. 5.504.4.3 Paints and coatings.
 - 3. 5.504.4.3.1 Aerosol paints and coatings.

4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
6. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing decorative railing systems and acceptable to manufacturer.
- C. Templates: Supply installation templates, reinforcing and required anchorage devices.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000.
- B. Mock-ups: Construct an example of each item specified. Locate mock-ups where directed.
- C. Provide full size mock-up of each type of railing system 6 feet long as directed by Architect.
 1. Locate where directed.
 2. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover, in a dry location.

1.08 FIELD CONDITIONS

- A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).
- B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product:
 1. C. R. Laurence Co., Inc.: www.crl-arch.com.
 2. Other Acceptable Manufacturers:
 - a. Global Glass Railings; Hercules system (base mounted): www.architecturalglassrailings.com.
 - b. Handrail Design Inc.: www.handrail-design.com.
 - c. Livers Bronze Co.: www.liversbronze.com.
 - d. Approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Design and fabricate railing and handrails in accordance with California Building Code 11B-505.

1. Top of gripping surfaces of handrails shall be 34 inches (863.60 mm) minimum and 38 inches (965.20 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
 2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2 inches (38 mm) minimum. Handrail may be located in a recess if the recess is 3 inches (76.20 mm) maximum deep and 18 inches (457.20 mm) minimum clear above the top of the handrail.
 3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1-1/2 inches (38 mm) minimum below the bottom of the handrail gripping surfaces.
 4. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4 inches (31.75 mm) minimum and 2 inch (50.8 mm) maximum.
 5. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4 inches (101.60 mm) minimum and 6-1/4 inches (158.75 mm) maximum, and a cross-sectional dimension of 2-1/4 inches (57.15 mm) maximum.
 6. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
 7. Handrails shall not rotate within their fittings.
 8. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
- B. Railings - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
1. Design Criteria: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
 - a. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot (730 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
 - b. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
 - c. Allow for expansion and contraction of members and building movement without damage to connections or members.
 - d. Concentrated Loads on Intermediate Rails: 50 pounds per square ft (0.22 per sq m), minimum.
 - e. AWS D1.6 - Structural Welding Code - Stainless Steel; 1999.
 2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
 3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
 4. Field Connections: Provide sleeves to accommodate site assembly and installation.
 5. Welded and Brazed Joints: Make exposed joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
 - a. Ease exposed edges to small uniform radius.
 - b. Welded Joints:
 - 1) Carbon Steel: Perform welding in accordance with AWS D 1.1/D1.1M.
 - 2) Stainless Steel: Perform welding in accordance with AWS D 1.6.

2.03 RAILING SYSTEM

- A. Dimensions: Refer to drawings for configurations and heights.

- B. Structural Glass Railing System - Base-Mounted: Engineered, base supported railing system with structural glass.
1. Configuration: Guardrail where top rail is also a handrail.
 - a. Stair Locations: Guardrail with separate handrail.
 2. Top Cap: 1-7/16 inch wide by 1-7/16 inch high by 11 gauge stainless steel; No. 4 satin finish.
 - a. Basis of Design Manufacturer:
 - 1) C.R. Laurence Company, Inc; L10 BS.
 3. Rubber Glass Insert: Flexible black rubber insert barrier between metal and glass for 27/32 inch thick laminated glass.
 - a. Basis of Design Manufacturer:
 - 1) C.R. Laurence Company, Inc; LR21PV.
 4. Base Shoe, Aluminum: ASTM B221 or ASTM B221M, 6063 alloy, T5 temper; 2-3/4 inch (69.85 mm) wide by 4-1/8 inch (105 mm) high, rectangular profile.
 - a. Basis of Design Product:
 - 1) C.R. Laurence Company, Inc; CRL L21S Series Mill Aluminum Square Base Shoe with drilled mounting holes.
 5. Cladding:
 - a. Material: 18 gage, 0.0500 inch (1.27 mm) stainless steel; No. 4 satin finish.
 - 1) Basis of Design Product:
 - (a) C.R. Laurence Company, Inc; CRL BSCBS10.
 6. Type GL-14 - Glass: Laminated safety glass; ASTM C1172, unless otherwise indicated.
 - a. Ionoplast Interlayer: Minimum 0.060 inch (1.52 mm) thick.
 - b. Impact Strength: Category II, tested in accordance with 16 CFR 1201.
 - c. Thickness: 3/4 inch (19 mm).
 - d. Configuration: As indicated on Drawings.
 - e. Edges: Ground smooth and polished.
 - f. Color: Clear, no tint.
 - g. Basis of Design Product:
 - 1) C.R. Laurence Company, Inc; CRL MG 19CC.
 7. Handrail: 1-1/2 inch outside diameter by 1/8 inch thick.
 - a. Stainless Steel Finish, Exposed Surfaces: No. 4 satin finish.
 - b. Basis of Design Product:
 - 1) C.R. Laurence Company, Inc; CRL HR15HBS 1-1/2 inch outside diameter tube.
 8. Handrail Brackets:
 - a. Stainless Steel Finish, Exposed Surfaces: No. 4 satin finish.
 - b. Basis of Design Product:
 - 1) C.R. Laurence Company, Inc; CRL HR15GBS.
 9. Fasteners:
 - a. Attachment to Concrete:
 - 1) Provide anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, tested in accordance with ASTM E488/E488M.
 - 2) Provide 12 inch (305 mm) center-to-center hole spacing; 1/2 by 4 inch (13 by 102 mm) concrete anchors.
 10. Basis of Design Manufacturer:
 - a. C.R. Laurence Company, Inc; CRL GRS TAPER-LOC Dry Glaze Glass Railing System: www.crl-arch.com.
 - 1) Approvals:
 - (a) ICC-ES ERS-3269.

2.04 MATERIALS

- A. Aluminum Components: ASTM B221 or ASTM B221M.
1. Mill Finish.

- B. Stainless Steel Components:
 1. ASTM A666, Type 304.
 2. Stainless Steel Finish: No. 4 Brushed Polished finish.

2.05 ACCESSORIES

- A. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal railings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District (SCAQMD) Rule No. 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
- D. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
 2. For anchorage to masonry, provide brackets to be embedded in masonry for bolting anchors.
 3. For anchorage to stud walls, provide backing plates for bolting anchors.

2.06 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- I. Form changes in direction as follows:
 1. As detailed.

- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

2.07 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.08 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

- A. Protect existing work.
- B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
- C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction

3.04 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.06 FIELD QUALITY CONTROL

- A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.07 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.
- C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

3.08 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.

1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

**SECTION 05 7511
ORNAMENTAL METAL MESH PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ornamental metal mesh panels for exit stairs and as indicated on Drawings.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
 2. Shop Drawings: Indicate system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
 3. Samples: Submit three of each item below for each type and condition shown.
 - a. Each type of exposed metal: 12 inch by 12 inch (305 mm by 305 mm), illustrating color, thickness and edge condition.
- B. Informational Submittals:
 1. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing decorative metal and acceptable to manufacturer.
- B. Templates: Supply installation templates, reinforcing and required anchorage devices.

1.05 MOCK-UP

- A. Mock-Ups: Construct an example of each item specified. Locate mock-ups where directed. Mock-ups may remain as part of the work.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

- D. Prior to installation, store materials and components under cover, in a dry location.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Ornamental mesh as indicated on Drawings.
- B. Panel Frames: Angle or channel frames of same material as mesh.

2.02 FABRICATION

- A. Fabricate panel frames and supports as indicated on Drawings.
 - 1. Provide mechanically jointed mitered corners.
- B. Install metal mesh in frames with wires parallel to frames in both directions; make mesh square prior to installation in accordance with manufacturer's instructions.
- C. After fabrication, touch up finishes or re-polish as required to restore original finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates to receive panels are ready for installation.

3.02 INSTALLATION

- A. Install panels as indicated.
- B. Whenever mesh panels are installed prior to completion of rough work, provide protective covers until the project is ready for occupancy.

END OF SECTION

SECTION 06 1053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL**1.01 SUMMARY**

- A. Section Includes:
1. Wood blocking and nailers.
 2. Plywood backing panels.

1.02 DEFINITIONS

- A. Blocking: Wood used for plates, furring, shimming, stripping, sleepers, grounds, curbing, cants, bracing, nailers, and filling in between framing members.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NLGA: National Lumber Grades Authority.
 2. WCLIB: West Coast Lumber Inspection Bureau.
 3. WWPA: Western Wood Products Association.

1.03 SUBMITTALS

- A. Action Submittals:
1. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - a. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - b. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - c. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - d. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - e. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
 2. Evaluation Reports: For the following, from ICC-ES:
 - a. Fire-retardant-treated wood.
 - b. Power-driven fasteners.
 - c. Powder-actuated fasteners.
 - d. Metal framing anchors.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 3. 5.504.4.5 Formaldehyde Limit requirements.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- B. Grade Marks:
 - 1. Identify lumber and plywood by official grade mark.
 - 2. Lumber: Include symbol of grading agency, mill name, grade, species, grading rules, and condition of seasoning at time of manufacturer.
 - 3. Plywood: Include type, class identification index, and agency mark.
 - 4. Pressure treatment: Include quality mark of grading agency which maintains continued supervision, testing, inspection, and re-examination service over product quality as described in AWWPA standards.
 - 5. Fire-retardant treated wood: Imprint each piece with mark attesting to FR-S rating.
- C. Certifications: Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Lumber and Plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001 and FSC STD-40-004.
- B. Regional Materials: Dimension lumber shall be manufactured within 100 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.
- C. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Provide dressed lumber, S4S, unless otherwise indicated.
- D. Maximum Moisture Content of Lumber: 15 percent for 2 inch (50.8 mm) nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.02 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWPA U1:
 - 1. Use Category UC3b for exterior construction not in contact with ground.
 - 2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.04 DIMENSION LUMBER FRAMING

- A. Framing: Construction or No. 2
 - 1. Douglas fir-larch; WCLIB or WWPA.

2.05 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.
 - 2. Hem-fir; WCLIB or WWPA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.06 PLYWOOD PANELS

- A. Equipment Panel Boards:
 - 1. Rated Sheathing.
 - 2. Exposure 1.
 - 3. Grade: A-CX, void free.
 - 4. Thickness: 23/32 inch (18.25 mm) minimum.

- 5. Painted.

2.07 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.08 METAL FRAMING ANCHORS

- A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- B. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- C. Stainless-Steel Sheet: ASTM A666, Type 304.
 - 1. Use for exterior locations and where indicated.

2.09 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 3. Adhesives and sealants shall meet or exceed the VOC and chemical component limits of SCAQMD 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 - a. Current requirement refers to the date on which the materials are installed in the building.

- b. A copy of SCAQMD 1168 is referenced in Section 01 8114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.03 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1 inch (25 mm) by 3 inch (76.20 mm) nominal-size furring horizontally and vertically at 24 inches (610 mm) o.c.

3.04 PROTECTION

- A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

**SECTION 06 1643
GYPSUM SHEATHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gypsum sheathing.
- B. Sheathing joint and penetration treatment.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide technical data on application instructions.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate: Certify that gypsum sheathing exceed specified requirements.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 3. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.01 CONSTRUCTION PANELS

- A. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, square long edges, 5/8 inch Type X fire-resistant (16 mm Type X fire-resistant).
 - 1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly.
 - 2. Edges: Square, for vertical application.
 - 3. Basis of Design Product:
 - a. Georgia-Pacific Building Products; Dens-Glass Gold Sheathing.
 - b. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - c. Temple-Inland Building Products by Georgia-Pacific; GreenGlass Exterior Sheathing.
 - d. United States Gypsum Co.; SecureRock.

2.02 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

- a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
 - b. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.
- B. Thermal Barrier Strips: Nanoporous aerogel thermal barrier strips.
- 1. Location: Between metal studs and gypsum sheathing, and as indicated on Drawings.
 - 2. Basis of Design Product:
 - a. Advanced Insolutions Inc; Proloft: www.advancedinsolutions.com.

2.03 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant at Glass Fiber Faced Gypsum Sheathing: Silicone-General Purpose (Designation S GP): ASTM C920, Type S, Grade NS:
- 1. Class: 50. Joint movement range without cohesive/adhesive failure: Plus 50 percent to minus 50 percent of joint width.
 - 2. Uses: NT, M, G, A, O
 - 3. Low modulus, single component, neutral curing, non-staining, non-bleeding silicone sealant.
 - 4. Color: Manufacturer standard.
 - 5. Acceptable Products:
 - a. Dow Corning; 795.
 - b. General Electric; Silpruf.
 - c. Rhone-Poulenc, Inc.; Rhodorsil 5C.
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
- 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- C. Sheathing Tape: Self-adhering rubberized asphalt tape.
- 1. Capable of being applied at temperature of 25 degrees F.
 - 2. Thickness: 30 mils.
 - 3. Permeance: 0.1 perms.
 - 4. Puncture Resistance: ASTM E514, 40 pounds-force, minimum.
 - 5. Tensile Strength of Membrane: ASTM D412, 600 PSI, minimum.
 - 6. Pliability: 180 degree bend over 1 inch (25 mm) at 25 degrees F.
 - 7. Primer: Manufacturer's required surface primer.
 - 8. Acceptable Products and Manufacturers:
 - a. Carlisle Coatings and Waterproofing; CCW MiraDRI 400VB Air/Vapor Barrier.
 - b. Grace Construction Products; Perm-A-Barrier Wall Membrane.
 - c. Henry Company; Henry Blueskin SA.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of framing members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.

3.04 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately 8 inches (203.20 mm) o.c. and set back a minimum of 3/8 inch (9.53 mm) from edges and ends of boards.
 - 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches (203.20 mm) o.c. and set back a minimum of 3/8 inch (9.53 mm) from edges and ends of boards.

END OF SECTION

SECTION 06 2013
EXTERIOR FINISH CARPENTRY

PART 1 GENERAL

1.01 INCLUDED WORK

- A. Provide Exterior wood construction as shown and specified on the Landscape Drawings. The work includes:
 - 1. Wood Benches
 - 2. Log Stumps and Steps

1.02 RELATED WORK

- A. Section 31 2000 – Earth Moving
- B. Section 32 1313 - Site Concrete

1.03 REFERENCES AND STANDARDS

- A. Lumber: Comply with American Softwood Lumber Standard PS-20-05. Provide lumber species complying with grading rules of following associations.
 - 1. Douglas Fir: Western Lumber Grading Rules, published by Western Wood Products Association (WWPA), or Standard Grading Rules for West Coast Lumber, Number 16, published by West Coast Lumber Inspection Bureau (WCLIB).
 - 2. Western Spruce, Pine, and Fir: Western Spruce-Pine-Fir Association (WSPFA) and current Canadian Grading Rules by National Grades Association Canada.
- B. Redwood: "Standard Specification of Grades of Redwood Lumber" of the California Redwood Association (CRA).
- C. Plywood: Grade-marked and manufactured in accordance with U.S. Product Standard PS-1-74, Softwood Plywood Construction and Industrial or one of American Plywood Association (APA) performance standards.
- D. Recycled Polymer Plastic Lumber: comply with pre-approved manufacturer's printed specifications.
- E. Design and detailing of wood framing connections: National Forest Products Association (NFPA) National Design Specifications for Wood Construction.
- F. Fasteners and nails: comply with NFPA Recommended Nailing Schedule of the Manual for House Framing.
- G. Wood Treatment: American Wood Preservers Association (AWPA) standards for wood preservative treatment scheduled.
- H. California Building Code, Chapter 23, 2013 Edition, unless otherwise noted.
- I. American Society for Testing and Materials, (ASTM).

1.04 QUALITY ASSURANCE

- A. Landscape Carpentry work shall comply with these specifications and all applicable sections of the above-named References and Standards.
- B. Provide each piece of plywood and/or lumber, factory grade-marked.
- C. Samples of Recycled Polymer Plastic Lumber.

1.05 SUBMITTALS

- A. Wood Treatment Data: Submit certification by treating plant indicating chemicals and process used and compliance with specified requirements.
- B. Submit manufacturer's product data for rough carpentry accessory and hardware items.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials dry during delivery and site storage. Stack materials to ensure proper drainage and ventilation. Protect from weather damage and deterioration.
- B. Store and protect rough hardware from weather damage and deterioration.

1.07 PROJECT CONDITIONS

- A. Coordination: Fit carpentry work to other work. Scribe and cope as required for accurate fit. Coordinate location of nailers, blocking, and similar supports to allow proper attachment of other work.
- B. Layout, cut, fit, and erect framing for rough and finished work. Provide blocking, nailers, and all other rough carpentry work. Do cutting work in connection with carpentry work for other trades. Brace, plumb, and level all members in true alignment and rigidly secure in place with sufficient nails, spikes, screws, and bolts as necessary.
- C. Lay out project work, set stakes, and batter boards.
- D. Provide wood framing, nailers, bracing, and supports required to support construction during formative stages. Set wood framing accurately to required lines and levels. Anchor members securely in place.
- E. Provide temporary rough carpentry work as indicated or required to construct the work. Maintain temporary items for the life of the work. Remove when no longer needed.
- F. Furnish and install miscellaneous hardware in connection with carpentry work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lumber:
 - 1. Nominal sizes are indicated. Provide actual size complying with PS-20-05 for moisture content indicated for each use, except where net sizes are indicated by detail dimensions.
 - 2. Provide dressed dimensioned lumber, S4S, kiln-dried or air-dried with maximum 19% moisture content.
 - 3. Provide rough sawn lumber, kiln-dried or air-dried with maximum 19% moisture content.
 - 4. Provide Western lumber WWPA, WCLIB, CRA or WSPFA species meeting stresses and grades scheduled.
 - a. All redwood to be deck heart construction grade
 - 5. Provide lumber pressure preservative treated, where wood comes into contact with soil and wherever indicated on the Drawings.
- B. Rough Hardware:
 - 1. Furnish bolts, plates, anchors, hangers, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to structures.
 - 2. Provide manufactured or fabricated items of sizes, shapes, and dimensions required.
 - 3. Bolts: ASTM A307, provide with malleable iron washers.
 - 4. Steel: ASTM A36.
 - 5. Mild Steel: ASTM A 283.

6. Fasteners and anchorages: Provide size, type, material, and finish required for nails, screws, bolts, nuts, washers, and anchoring devices. Provide with aluminum, stainless steel or hot-dip galvanized finish fasteners and anchorages size and type to suit application.
7. Provide toggle bolt type anchorage of framing to hollow masonry and expansion shield and lag bolt type for anchorage to solid masonry or concrete and bolts or power activated type for anchorage to steel.
8. Metal connectors: Galvanized steel hangers, ties, and anchors sized for full load carrying capacity of supported members. Simpson or equal.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate under which carpentry work is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Obtain field measurements and verify dimensions and details before proceeding with rough carpentry work.

3.03 INSTALLATION

- A. Set wood framing accurately to required lines and levels. Provide with framing members of sizes and on spacings shown. Cut, join, and tightly fit framing around other work. Do not splice structural members between supports.
- B. Set posts plumb and true to line and grade.
- C. Use only treated, sound, thoroughly seasoned materials of longest practical lengths and sizes to minimize joints. Use materials free of warp unless warp can be easily corrected by anchorage and attachment. Make tight connections between members. No shimming will be allowed.
- D. All wood surfaces shall be sanded where necessary to remove undesirable rough edges. All knot holes, pitch pockets, or sappy portions shall be sealed with an approved resin sealer.
- E. Metal work shall be fabricated to the details shown, shall have all brackets necessary for the attachment of woodwork.
- F. Select individual pieces of lumber so that knots and obvious minor defects will not interfere with placing of bolts, proper nailing, or making of proper connections. In exposed locations, select for appearance satisfactory to the Architect.
- G. Framing shall be closely fitted, accurately set in plumb planes to required lines and levels and rigidly secured in place. Beams shall be set with crowned edge up; bottom edges shall be free from pronounced defects. Special framing or construction, not explicitly shown or specified, shall be provided as directed by the Architect to complete work in the best workmanlike manner.
- H. Provide all bolting, nailing and other fastenings required to complete the wood construction shown on the Drawings.
- I. Bolt holes shall be 1/32-inch to 1/16-inch larger than bolts and shall be accurately located to permit proper alignment of members and easy driving of bolts. A malleable iron washer, or the equivalent thereof, shall be installed between each bolt head and nut and wood. Bolts shall be taken up snug and shall be retightened at the latest practicable time during the construction work.
 1. Vandal-proof all bolting and other connections by burring threads.
- J. Anchor and nail framing to comply with NFPA Recommended Nailing Schedule of the Manual for House Framings.

- K. Nailing shall be done in a workmanlike manner; care being exercised to avoid splitting wood. All nailing clips, hangers, and the like shall receive full number of nails of proper size as furnished with clips or recommended in manufacturer's printed instructions.
- L. Edges of handrails, beams, etc. where contact with people will occur shall be rounded and smoothed.
- M. Provide sill plates where wood framing is supported by concrete or masonry. Anchor to embedded bolts.
- N. Brush apply 2 coats of an acceptable wood preservative to surfaces of preservative treated lumber that are field cut, dressed, or drilled.
- O. Prior to filling the boxes with soil, install the gopher wire, turn down the wire into the soil and staple it to the edges of the box.

3.04 CLEANING

- A. Clean up debris and cuttings on a regular periodic basis.
- B. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, tools, and equipment. Repair damage resulting from rough carpentry work.

END OF SECTION

SECTION 06 4116

PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Field verify critical dimensions and clearances prior to fabrication of casework items; assure that field conditions are as required to comply with indicated design requirements.
 - 2. By accurate field measurements before being enclosed, verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork; record measurements on shop drawings.
 - 3. Coordinate construction to ensure that actual dimensions correspond to established required dimensions.
- B. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this Section; require attendance by all affected installers.
 - 1. Agenda:
 - a. Discuss and agree upon acceptable delivery, storage, and handling, environmental conditions, preparatory work, and methods of installation.
 - b. Review coordination and environmental controls required for proper installation and ambient temperature and humidity conditioning in areas to receive woodwork.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 2. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot (1:8).
 - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 4. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural wood cabinets.
 - 5. Show plastic laminate with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 - 6. Provide the information required by AWMAC/WI (NAAWS).
 - 7. Shop drawings are required to be generated as separate digital drawings specific to this Project, not utilizing Architect's digital drawing files in any manner.
 - 8. Show all adjacent construction including abutting walls, columns and similar elements affecting casework installation.
 - 9. Use Owner's casework designation system on shop drawings; system will be provided by Owner prior to preparation of shop drawings.
 - 10. Product Data: Provide data for hardware accessories.
 - 11. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
 - 12. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
 - 13. Samples for Verification:

- a. Plastic laminates, 12 by 12 inches (300 by 300 mm), for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - b. Wood-grain plastic laminates, 12 by 24 inches (300 by 600 mm), for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - c. Thermoset decorative panels, 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish, with edge banding on one edge.
 - d. Corner pieces as follows:
 - 1) Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches (452.70 mm) high by 18 inches (452.70 mm) wide by 6 inches (150 mm) deep.
 - 2) Miter joints for standing trim.
 - e. Exposed cabinet hardware and accessories, one unit for each type and finish.
- B. Informational Submittals:
- 1. Qualification Data: For installer.
 - 2. Product Certificates: For each type of product.
 - a. Composite wood and agrifiber products.
 - b. Thermoset decorative panels.
 - c. Adhesives.
 - 3. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.
 - 4. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements - LEED.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - a. Plastic-laminate cabinets shall be manufactured within 500 miles of project site.
 - 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 6. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Single manufacturer shall provide and install work described in this Section.
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Installer Qualifications: Fabricator of products, Certified participant in AWI's Quality Certification Program and Licensee of WI's Certified Compliance Program.

- D. Quality Certification: Provide WI Certified Compliance Program (CCP) inspection report and quality certification of completed work.
- E. Fabrication and Installation Standards: Fabricate and install in accordance with North American Architectural Woodwork Standards – 3.0 as listed below.
 - 1. Lumber grades: Section 3.
 - 2. Panel products: Section 4.
 - 3. Casework: Section 10.
- F. Woodwork Certification:
 - 1. Before delivery to jobsite, woodwork supplier shall submit Woodwork Institute Certified Compliance Certificate indicating millwork products being supplied and certifying that products fully meet the requirements of Grade or Grades specified.
 - 2. Each elevation of casework, each laminated plastic top, and each solid surface top shall bear Woodwork Institute Certified Compliance Label.
 - 3. At completion of installation, woodwork installer shall provide Woodwork Institute Certified Compliance Certificate indicating the products installed, and Certifying that the installation of these products fully meets the requirements of the Grade or Grades specified.
 - 4. All fees charged by the Woodwork Institute for their Certified Compliance program are responsibility of millwork manufacturer and/or installer and shall be included in their bid.
 - 5. The foregoing shall not be construed to limit power and authority of Owner to reject any millwork which does not in Owner's opinion meet with any one or more of the specifications of this Contract.
- G. Fees charged by Woodwork Institute for Monitored Compliance Program are responsibility of Contractor.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000 - Quality Requirements.
- B. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework items to installation areas only after clean, well ventilated, and temperature-controlled installation areas are available. Do not deliver casework items to installation areas until painting and similar operations are complete in those areas.
- B. Protect units from moisture and impact damage during transit, delivery, and storage; use protective covers during delivery, storage, and handling operations..

1.08 ENVIRONMENTAL CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 deg F (15.5 deg C) and 90 deg F (32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.
- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.09 WARRANTY

- A. Furnish warranty with provisions for repairing or replacing, at no additional cost to Owner, architectural woodwork items that exhibit defects in material or workmanship for 2 years.

PART 2 PRODUCTS

2.01 CABINETS

- A. Operable parts for all accessible casework shall comply with CBC Section 11B-309.
- B. Quality Grade: Unless otherwise indicated provide products of quality specified by North American Architectural Woodwork Standards – 3.0 for Custom Grade.
 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.02 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Refer to Finish Schedule for selected products and finishes
- B. Quality Standard: Premium Grade, in accordance with AWMAC/WI (NAAWS) , unless noted otherwise.
 1. Provide certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- C. Regional Materials: Plastic-laminate cabinets shall be manufactured within 500 miles (800 km) of Project site.
- D. Certified Wood: Plastic-laminate cabinets shall be made from wood products certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Drawers, doors, leg mechanisms, trays, and other operating parts must be wobble, rattle, and squeak free, well fitted, properly aligned, and smoothly operable without loose or sloppy action.
- F. Finished Goods: Meet ASTM F2057 Anti-Tipping Test and/or appropriate restraining methods must be noted on shop drawings and supplied with each unit.
- G. Millworker to provide weight information of units and advise any/all necessary in -wall / in-ceiling blocking to support weight of unit, where applicable.
- H. All public space millwork must be suited for heavy F&B environments.
- I. Millwork bases must be able to structurally support specified tops without easily tipping over when weight is applied to any one side and must have self-leveling capabilities or use FLAT Technology to avoid rocking and tipping.
- J. Type of Construction: Frameless.
- K. Cabinet and Door and Drawer Front Interface Style: Flush overlay.
- L. Case: Plywood with plastic laminate.
- M. Drawer Sides and Backs: Solid-hardwood lumber.
 1. Species: Birch, flear coat.

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Child Development Center
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- N. Drawer Bottoms: Hardwood plywood.
 - 1. Species: Birch, flear coat.
- O. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- P. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued dovetail joints.
- Q. Cabinets :
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Exposed Interior Surfaces: Thermoset decorative panels.
 - 3. Finish - Concealed Surfaces: Thermoset decorative panels.
 - 4. Casework Construction Type: Type A - Frameless.
 - 5. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.

2.03 WOOD-BASED COMPONENTS

- A. Regional Materials: Wood products shall be manufactured within 100 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.
- B. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
- C. General: Comply with regionally-sourced, recycled content, adhesives and sealants, and aerosol adhesives product requirements specified in Section 018113.
- D. Adhesives: Comply with urea-formaldehyde prohibition, adhesives and sealants, and VOC limitations product requirements specified in Section 018113.
- E. Wood fabricated from old growth timber is not permitted.
- F. Provide sustainably harvested wood, certified or labeled as specified in Section 018113.
- G. Provide wood harvested within a 500 mile (805 km) radius of the project site.

2.04 LAMINATE MATERIALS

- A. Refer to Finish Schedule for selected products and finishes.
- B. High Pressure Decorative Laminate (HPDL) - Plastic Laminate: NEMA LD 3, types as recommended for specific applications.
 - 1. Provide specific types as follows:
 - a. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
 - b. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
 - c. Post-Formed Horizontal Surfaces: HGP, 0.039 inch (1.0 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
 - d. Post-Formed Vertical Surfaces: VGP, 0.028 inch (0.71 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
 - e. Cabinet Liner: CLS, 0.020 inch (0.51 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
 - f. Laminate Backer: BKL, 0.020 inch (0.51 mm) nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.
 - g. Edges: Grade HGS.

- 1) Semiexposed Surfaces: Grade HGS.
 - 2) Edges of Thermoset Decorative Panel Shelves: PVC T-mold matching laminate in color, pattern, and finish.
- h. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

2.05 COUNTERTOPS

- A. Countertops: Specified in Section 12 3600 - Countertops.

2.06 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76.20 mm) wide.
 2. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
 2. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
 3. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 4. Medium-Density Fiberboard: ANSI A208.2, Grade 130 and made with binder containing no urea formaldehyde.
 5. Thickness:
 - a. Panel structural components: Minimum 3/4 inch (19.05 mm) thick.
 - b. Back Panels, Drawer Components, and Drawer Bottoms: Minimum 1/2 inch (12.70 mm) thick.
 - c. Fixed Shelves, Dividers, Mounting Stretchers: Minimum 3/4 inch (19.05 mm) thick.
 - d. Semi-exposed Adjustable Shelves in Cabinets under 36 inches (914 mm) Wide: Minimum 3/4 inch (19.05 mm) thick.
 - e. Shelves in Cabinets 36 inches (914 mm) Wide or Greater: Minimum 1 inch (25 mm) thick.

2.07 ACCESSORIES

- A. Adhesive: Type recommended by WI to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.08 HARDWARE

- A. Refer to Finish Schedule for selected products and finishes.

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- B. Hardware Finish: With exception of finish hardware items which have finishes specified, hardware shall be furnished with dull chrome US 26D or dull stainless steel US 32D finish.
- C. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- D. Shelf Rests: BHMA A156.9, B04013; metal.
 - 1. Location: 4 per shelf.
 - 2. Basis of Design Product:
 - a. Hafele 282.04.711.
 - b. Hafele 282.24.13.
 - c. Knape & Vogt 333.
 - d. Lamp SS 323.
 - e. Approved equal.
- E. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).
 - 1. Finish: Satin Nickel on steel.
 - 2. Acceptable Manufacturers:
 - a. Basis of Design: Hafele 116.07.622, or equal.
 - b. Approved equal.
- F. Locks:
 - 1. Key locks inside one room alike. Furnish 3 keys for each lock keyed separately, and 2 keys for each lock keyed alike in groups. Master keys shall be tagged and delivered to the Owner Representative. Locks and keys shall be stamped with coded set number/direct digit.
 - 2. series. Change keys shall also be stamped with set numbers direct digit.
 - 3. Cabinet locks shall be master-keyed and keyed alike. Backside of cabinet lock bolts (on visible side following installation) and change keys shall be stamped with manufacturer's code, either direct digit or coded.
 - 4. Master Keys: National GM2
 - 5. Drawer Locks: Keyed cabinet-grade lock, two keys per lock, steel with satin finish.
 - a. General: Disc or pin tumbler, surface mounted.
 - b. Acceptable Products:
 - 1) National Cabinet Lock; 68-3718 x 68-2480C brass strike.
 - 2) Olympus; 200 DW x 12-1 strike.
 - 3) Approved equal.
 - 6. Cabinet Locks: Keyed cabinet-grade lock, two keys per lock, steel with satin finish.
 - a. General: Disc or pin tumbler, surface mounted.
 - b. Acceptable Products:
 - 1) National Cabinet Lock; No. 3713 x 2475-172.
 - 2) Olympus; 100DR x 12-1 strike.
 - 3) Approved equal.
 - 7. Sliding Door Locks: Keyed cabinet-grade lock, two keys per lock, steel with satin finish.
 - a. General: Disc or pin tumbler, surface mounted.
 - b. Acceptable Products:
 - 1) National Cabinet Lock; No. 3713 x 2475-172.
 - 2) Olympus; 100DR x 12-1 strike.
 - 3) Approved equal.
- G. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
 - 1. Acceptable Products:
 - a. Epco; No. 592.
 - b. Lawrence; No. SC1364-AL.
 - c. Approved equal.
- H. Drawer Slides

1. Type: Full extension, self-closing, with positive in-stop, out-stop and out-keeper to maintain drawer in 80 percent open position.
 2. Captive nylon rollers, front and rear.
 3. Adjuster cam to regulate body side sway.
 4. Finish: Epoxy powder coated to match drawer body color.
 5. Static Load Capacity: Commercial grade.
 - a. Grade 1HD-100 unless noted otherwise.
 - b. For drawers more than 6 inches (150 mm) high or more than 24 inches (610 mm) wide, provide Grade 1HD-100.
 - c. File Drawers: Full extension, 3-part progressive opening slide, Grade 1HD-100 minimum.
 - 1) File Drawer Accessory: Follower and track assembly.
 - (a) Knape & Vogt Manufacturing Company; No. 476.
 - (b) Pendaflex Rack.
 - d. Paper Storage Drawers: Full extension, 3-part progressive opening slide, Grade 1HD-100 minimum.
 - e. For computer keyboard shelves, provide Grade 1HD-100
 - f. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-200.
 6. Mounting: Side mounted.
 7. Stops: Integral type.
 8. Features: Provide self closing/stay closed type. Grade 1
 9. Acceptable Manufacturers:
 - a. Grass America Inc.: www.grassusa.com.
 - b. Hettich America, LP: www.hettichamerica.com.
 - c. Knape & Vogt Manufacturing Company: www.knapeandvogt.com.
 - d. Approved equal.
- I. Standard Hinges: European style concealed, self-closing type, steel with satin finish.
1. Opening: 170 degrees of opening, self-closing.
 2. Acceptable Manufacturers:
 - a. Hafele America Co.; No. 326.05: www.hafele.com
 - b. Julius Blum, Inc.; No. B71650: www.blum.com.
 - c. Mepla, No. MD61-253-Z00
 - d. Approved equal.
- J. Mutes: Rubber, approximately 1/4 inch (6.35 mm) diameter, colors to match adjacent finish.

2.09 FABRICATION

- A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 1. Corners of Cabinets: 1/16 inch (1.58 mm) unless otherwise indicated.
- B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to

produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

- D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- E. Edges: Solid wood and slightly eased square mitered corners, sanded smooth, sealed, finished.
- F. Millwork must be properly scribed to adjacent walls and ceilings as necessary where applicable.
- G. Back Panels: Glued and securely fastened by screws or gun staples.
- H. Route lines, cutouts or grooves must be smoothly machined and/or sanded. Shapes, carvings, and 'U' cuts are to be finished smoothly with no visible unfinished or rough areas.
- I. Drawers and Doors:
 - 1. Fitted, properly aligned, and must operate smoothly under various atmospheric conditions.
 - 2. Top edges of drawer sides and backs must be sanded flat with beveled edges and rounded bottom and covered with a clear lacquer sealer coat. Glued-up stock must match in color.
 - 3. Drawer Sides: Finished smooth with clear lacquer sealer coat or melamine in appropriately coordinated color.
 - 4. Drawer Joints: Multi (English) dovetail or linear (French) dovetail and well-glued, fitted, puttied and sanded.
 - 5. Drawer Bottoms: Contained in dadoes on all four sides, and glue-blocked in place to assure continuing squareness.
 - 6. Drawer Box Screws: Recessed into drawer box.
 - 7. Drawers: Sealed on inside backs, fronts, side partitions, bottoms, outside sides and backs.
 - 8. Doors: Finished same on both face and interior of door panel.
 - 9. Doors: Uniform in clearance. Catches must be properly aligned and installed.
 - 10. Provide rubber bumper pads on door panels to prevent door from improperly banging into divider panel.
- J. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- K. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- L. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Apply low pressure laminate to inside of cabinets on exposed and semi-exposed surfaces, and to shelving surfaces.
 - 3. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- M. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this Section.
- C. Verify critical clearances and dimensions prior to installation of casework items.

3.02 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
 - 1. Condition cabinets to humidity conditions 72 hours minimum.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.03 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop
- C. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- D. Use fixture attachments in concealed locations for wall mounted components.
- E. Use concealed joint fasteners to align and secure adjoining cabinet units.
- F. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim for this purpose.
- G. Secure cabinets, counter bases, and other casework to floor using appropriate angles and anchorages.
- H. Secure full height cabinets, shelving units, and similar casework items exceeding 60 inches in height to floor using appropriate angles and anchorages
- I. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch (3.17 mm) in 96 inches (2438.40 mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Provide fabricator's standard concealed fasteners.
 - 4. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

3.04 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.
- C. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

3.05 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.06 PROTECTION

- A. Protect installed casework items from damage due to subsequent construction operations.

END OF SECTION

SECTION 06 8316
FIBER GLASS REINFORCED PLASTIC (FRP) PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Accessories and trim.

1.02 SUBMITTALS

- A. Refer to Section 013300 - Interior Doors Performance Requirements, for submittal procedures.
- B. Action Submittals:
 - 1. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 - 2. Samples: Submit two samples 4 by 4 inch (102 by 102 mm) in size illustrating material and surface design of panels.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Panels: Quantity equal to 5 percent of total installed.

1.03 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.05 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS - GENERAL

- A. Refer to Finish Schedule for finish material selections and finishes.

2.02 PANEL SYSTEMS

- A. Wall Panels:
 - 1. Panel Size: 4 by 10 feet (1.2 by 3.0 m).
 - 2. Panel Thickness: 0.09 inch (2.3 mm).
 - 3. Surface Design: Smooth.
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
 - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
 - 4. Impact Strength: Greater than 6 ft lb force per inch (320 J per m), when tested in accordance with ASTM D256.
 - 5. Sanitation and Cleanability: Comply with 9 CFR 416.2.
 - 6. Wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Trim: Vinyl; color coordinating with panel..
- C. Adhesive: Type recommended by panel manufacturer.
 - 1. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 - a. Current requirement refers to the date on which the materials are installed in the building.
 - b. A copy of SCAQMD 1168 is referenced in Section 01 8114 - Greenhouses that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- D. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 - Joint Sealants.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches (300 mm) wide.
 - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
 - 2. Locate panel joint to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

AE3 Partners
DSA Application No. 01-119166
September 7, 2021

Increment 1
06 8316 - 4

Merritt College
Child Development Center
FIBER GLASS REINFORCED PLASTIC
(FRP) PANELS

**SECTION 07 1413
HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. 215 mil Rubberized-asphalt waterproofing with membrane reinforcement.
2. Protection course.

B. Related work specified elsewhere:

1. Division 03: Cast-in-place concrete, precast concrete.
2. Division 04: Unit masonry.
3. Division 07: Flashing and sheet metal, metal wall cladding panels, thermal insulation, moisture protection, joint sealant.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations and extend of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

C. Certifications: Submit material certifications signed by manufacturer certifying materials comply with specific performance characteristics and physical requirements.

1. Certification must evident that all materials are supplied by a single source manufacturer.

D. Installer Qualifications: Submit at time of bid, manufacturer's written document that installer is certified as a current Approved Applicator with manufacturer.

E. Product test reports:

1. Manufacturer's test reports.
2. Field water test reports.

F. Warranty: Submit sample copy of manufacturer's warranty identifying the terms and conditions.

1. Warranty covering hot rubberized asphalt waterproofing, air and moisture barrier, and singly ply roofing system shall be provided by a single manufacturer.

G. Provide Manufacturers ISO 9001 Certificate.

H. Financial Certification: Provide the building owner with a signed and notarized (sealed) affidavit by an officer of the system supplier which confirms a current minimum corporate asset-to-liability ratio of not less than 3:1 for the supplier, or its parent corporation. Financial support information and affidavit must be dated within 30 days prior to the product submittal.

I. Manufacturers Inspections: Provide notarized statement signed by a corporate officer of the hot rubberized asphalt waterproofing system guaranteeing the requirements listed in 3.5 FIELD QUALITY CONTROL will be provided to the owner and architect at no charge to the district.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer must be a company with a minimum of at least (3) three years' experience in work of the type required by this section, who can comply with the manufacturer's warranty requirements, and who is an approved Applicator as determined by manufacturer.
- B. Pre-Installation Conference: Conduct conference at project site.
- C. Manufacturer Qualifications: Manufacturer must be a company with a minimum of forty (40) years in the direct production and sales of waterproofing materials.
 - 1. Manufacturer shall be capable of providing field service representation during construction and recommending installation methods.
 - 2. Manufacturer shall have certified, approved applicators for membrane installation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in original unopened package, clearly marked with manufacturers labels indicating name of manufacturer, product, and all identifying numbers.
- B. Storage: Storage of materials must be in an appropriate location and manner as to protect from any construction damage, as well as damage from weather, prolonged sunlight, excessive temperature and sources of ignition. Remove any damaged material from job-site and dispose of in accordance with applicable regulations. Do not double stack pallets during shipping or storage. Allow adequate ventilation.
- C. Handling: Handling of materials to be in accordance with manufacturer's instructions. Melting equipment shall consist of double jacketed, oil bath melter with mechanical agitator. Avoid overheating of hot applied rubberized asphalt.

1.5 PROJECT CONDITIONS

- A. Regulatory Requirements: All federal, state, and local regulations, codes, and safety standards must be adhered to always.
- B. Installation Requirements
 - 1. Do not apply waterproofing system if temperature is less than 0°F. Application of hot applied rubberized asphalt shall not be performed during rain, snow, or inclement weather; or on frost or wet covered surfaces.
 - 2. The deck must be properly cleaned and prepared free of all contaminations then primed with specified primer.
 - 3. The work area must be adequately ventilated. Warn personnel against breathing of vapors and contact of material with skin and eyes. Limit access to required personnel during the installation process. Do not use flammable products near spark or an open flame. Do not allow the uses of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs. Wear appropriate protective clothing and respiration protection gear always.
 - 4. Protect adjoining surfaces not to be waterproofed against damage or soiling, including plants, vegetation, and animals that may be affected by the waterproofing operations.
 - 5. Protection at completion of work: Provide adequate protection for membrane after installation. Do not allow any foot or vehicular traffic on unprotected membrane. Do not allow any material or waste product to contaminate membrane. Contact manufacturer to determine performance impedance, if any, caused by contamination of the membrane.

1.6 WARRANTY

- A. Upon completion of work, contractor shall provide owner with a single source warranty.
 - 1. Warranty must be validated by manufacturer confirming acceptance of installation, including inspection reports, in accordance with all applicable instructions.
 - 2. Warranty for hot fluid applied rubber asphalt waterproofing, air/moisture barrier, and single ply roof membrane shall be provided by a single manufacturer.

- B. Manufacturer’s Warranty: Upon completion and acceptance of the work required by this section, the waterproofing materials manufacturer will provide a written ten (10) year limited warranty to the project owner. Manufacturer’s warranty shall be independent from any other warranties made by the contractor under requirements of the Contract Documents and may run concurrent with the other warranties. Issuance of manufacturer’s warranty requires the following:
 - 1. Waterproofing system products, drainage, and insulation course products, and subsequent assembly products shall have been provided by a single manufacturer.
 - 2. Installation of waterproofing products, drainage and insulation course (if used) products and subsequent products by Manufacturer’s Approved Applicator.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Provide waterproofing and assembly materials manufactured or supplied by The Garland Company, 3800 East 91st, Cleveland, Ohio 44105 USA. Local representative: Doug Clark (925) 784-6701 email: dclark@garlandind.com
 - 1. OR EQUAL

2.2 WATERPROOFING MEMBRANE

- A. Dura-Walk CWH: Hot Fluid-Applied, Rubberized-Asphalt Waterproofing membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.
- B. Flashing Sheet: Versiply 80 – 80-mil high strength, puncture and fatigue resistant SBS rubber modified roofing membrane.
- C. Primer: ASTM D 31, asphaltic primer: Garla-Prime VOC
- D. Protection/Separation layer: Versiply 80 - 80-mil high strength, puncture and fatigue resistant SBS rubber modified roofing membrane.
- E. Sealants and Accessories: Tuff-Stuff MS and as recommended by manufacturer.
- F. Reinforcing Fabric: HPR Polyscrim Plus – 5.9-oz/yd² continuous filament, point bonded, chemically treated, polyester mat.

PART 3 - PREPERATION & EXECUTION

3.1 PREPERATION

- A. Cast-in-place concrete or composition decks must be monolithic, smooth, and free of voids, spalled areas, laitance, honeycombs, and protrusions. New concrete should be cured 28-days with a light brush of wood float finish texture. A steel float finish will provide too smooth of a surface for proper adhesion of the waterproofing materials, therefore concrete surfaces that have a steel float finish must be mechanically treated prior to the application of the waterproof material.
- B. All joints must be grouted.

- C. Remove all dirt, debris, oil, grease, cement laitance or other foreign matter which will impair the adhesion and performance of the waterproofing membrane.
- D. Protect adjacent work areas and finished surfaces from damage or contamination during installation operations.
- E. Expansion joints should be sealed with applicable expansion joint material. Detail waterproofing membrane to expansion joint per manufacturer's standard details.
- F. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- G. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- H. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- I. Remove Grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- J. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.2 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
- B. All details and flashings must be completed in accordance with Manufacturer's most recent installation guidelines and detail drawings. Non-moving cracks and joints up to 1/16" (1.6mm) require no special treatment.
- C. Reinforce all non-moving cracks and joints 1/16" to 3/16" in width with minimum 6" wide strip of Versiply 80 or a minimum 6" wide strip of HPR Polyscrim Plus fabric reinforcement embedded in 90-mil thick by 9" wide tack coat of Dura-Walk CWH. Embed the reinforcement while the tack coat is still warm and tacky. Overlap reinforcement strip ends a minimum 2", ensuring lap receives rubberized asphalt.
- D. Reinforce all non-moving cracks and joints 3/16" to 1/2" in width with minimum 6" wide strip of VERSIPLY 80 or HPR POLYSCRIM PLUS embedded in 90-mil thick by 9" wide tack coat of DURA-WALK CWH. Embed the reinforcing while the tack coat is still warm and tacky. Overlap reinforcing strip ends a minimum 2", ensuring lap receives rubberized asphalt.
- E. Deck-to Deck Wall Transitions: Install VERSIPLY 80 up face of wall per project requirements and extend flashing onto deck a minimum 6" without wrinkles or fish mouths. Overlap flashing end laps a minimum 6". Apply DURA-WALK CWH membrane to deck corner over flashing extending onto horizontal deck; with HPR POLYSCRIM PLUS reinforcing fabric terminating minimum 1" prior to membrane termination at deck corner.
- F. Deck-to Below Property Line Wall Transitions: Install minimum 90-mil thick by 12" wide tack coat of DURA-WALK CWH at perimeter deck edge along property line wall. Apply minimum 90-mil base layer of DURA-WALK CWH membrane as a continuous monolithic coat over entire deck area to be waterproofed. Fully embed a layer of HPR POLYSCRIM PLUS reinforcement fabric into the top surface of the base coat. Apply minimum 125-mil top layer of HPR POLYSCRIM PLUS hot applied rubberized asphalt membrane over the reinforcing fabric in a continuous monolithic coat. While the top layer is still warm and tacky, lay down and embed the minimum 12" exposed section of the property line wall waterproofing membrane into the top coat of the DURA-WALK CWH. Finally, apply a minimum 60-mil thick by 18" wide seal coat of DURA-WALK CWH at perimeter deck edge along property line wall.
- G. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet per manufacturer's recommendations

3.3 FLASHING INSTALLTION

- A. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.

3.4 MEMBRANE APPLICATION

- A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow drying.
- B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
- C. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil- thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.
- D. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.
- E. Cover waterproofing with protection course per manufacturer's' recommendations.

3.5 FIELD QUALITY CONTROL

- A. Notify the Owner/Architect one day prior to date of performing tests. Before concealment, cover rubberized asphalt waterproofing horizontal surfaces over finished spaces with ponded water (minimum 2" in depth) for 24 hours. Do not add water after start of 24-hour period. Carefully measure water level at beginning and end of 24-hour period. If water level falls, remove water and inspect waterproofing membrane and the underside of the concrete structural deck. Make repairs or replacement as directed and repeat test. DO NOT proceed with work that conceals membrane waterproofing before receiving approval and acceptance of owner/architect in writing. Record results and submit all test reports as sections are completed.
- B. A full-time employee of the manufacturer must provide job site inspections a minimum of 3 times per work week and provide detailed report to owner and architect with pictures and comments of the project progress.

3.6 PROTECTION AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

**SECTION 07 2100
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation.
- B. Batt insulation
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work of this Section with requirements for vapor retarder and air barrier seal specified in Section 07 2500 - Weather Barriers.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Informational Submittals:
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
 - 2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.05 QUALITY ASSURANCE

- A. Comply with fire resistance and flammability ratings as shown and specified.
- B. Thicknesses specified are for the thermal conductivity (k-value at 75 degrees F) specified for each material. Provide adjusted thicknesses for approved use of substituted materials with different thermal conductivity ratings. Where insulation is specified to have a specific "R" value, furnish manufacturer's standard thickness required to equal or exceed the specified value.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.
- B. Protect plastic insulation from exposure to direct sunlight.
- C. Do not deliver plastic insulation materials to the project site ahead of time of installation. Protect at all times against ignition. Complete the installation and concealment of plastic materials as soon as possible in each area of work.

1.07 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. General: Comply with regionally-sourced, recycled content, urea-formaldehyde prohibition, adhesives and sealants, aerosol adhesives, and volatile organic compound (VOC) product requirements specified in Section 018114.
- B. Where units are included in fire rated wall, ceiling, or floor construction, provide insulation units which have been tested and rated as required for the indicated assembly.
- C. Materials of This Section: Provide a continuous thermal, and vapor and air barrier at building enclosure elements.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
 - 1) Class 2 - Glass fiber reinforced or non-reinforced core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 3 - 25 psi (172 kPa), minimum.
 - 3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; 9.0 (1.59), minimum, at 75 degrees F (24 degrees C).
 - 2. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 - 3. Board Thickness: As indicated on Drawings.
 - 4. Basis of Design Product:
 - a. Dow Chemical Company; THERMAX Heavy Duty: www.dowbuildingsolutions.com.
 - b. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
 - c. Hunter Panels; Xci Foil (Class A): www.hunterpanels.com/#sle.
 - d. Johns Manville; AP Foil-Faced: www.jm.com/#sle.
 - e. Approved equal.

2.03 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. LEED Requirements: 25% postconsumer recycled content or 50% pre-consumer recycled content minimum.
- C. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Complies with fire-resistance requirements shown on the Drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285, 2012 Edition.
 - 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84, 2009 Edition.
 - 3. Smoke Developed Index: 50 or less except as otherwise specified, when tested in accordance with ASTM E84, 2009 Edition.
 - 4. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 5. Formaldehyde Content: Zero.
 - 6. Provide insulation made with minimum 25 percent recycled glass content.
 - 7. Thermal Resistance: As noted on Drawings, minimum value.
 - 8. Facing: Provide un-faced.

9. Acceptable Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville: www.jm.com.
 - c. Owens Corning Corp.: www.owenscorning.com.
 - d. Prior approved equal.

- D. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Complies with fire-resistance requirements shown on the Drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 3. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 4. Acceptable Products:
 - a. Johns Manville; Mineral Wool TempControl Batts: www.jm.com.
 - b. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com.
 - c. ROCKWOOL (ROXUL, Inc); AFB: www.rockwool.com.
 - d. Thermafiber, Inc; SAFB FF: www.thermafiber.com.
 - e. Approved equal.

2.04 ACCESSORIES

- A. Spray Foam Fill Insulation: Single component polyurethane-based spray foam.
 1. Location: Tight spaces that batt insulation will not fit.

- B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
 3. Products:
 - a. AGM Industries, Inc; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 - c. Approved equal.

- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square.
 1. Products:
 - a. AGM Industries, Inc;; SC150.
 - b. Gemco;; S-150.
 - c. Approved equal.

- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
 1. Products:
 - a. AGM Industries, Inc; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.
 - c. Approved equal.

- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inch (31.75 mm), wall attachment flange of 7/8 inch (22.22 mm), minimum bare-metal thickness of 0.33 inch (0.84 mm), and depth required to fit insulation thickness indicated.

- F. Adhesive: Type recommended by insulation manufacturer for indicated applications.
 1. Comply with adhesives and sealants and volatile organic compound (VOC) product requirements specified in Section 08 8114.

- G. Adhesives shall meet VOC and chemical component limits of SCAQMD 1168 and CAL-Green Table 5.504.4.1 Adhesive VOC Limit requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

3.02 INSTALLATION OF BOARD INSULATION BELOW ROOF/CEILING DECK

- A. Install board insulation in accordance manufacturer's written instructions.
- B. Adhere impaling clip in accordance with manufacturer's recommendations.
- C. Impale insulation onto impaling clip. Butt joints tight and tape. Install retaining washer.

3.03 ATTACHMENT AND SUPPORT FRAMING INSTALLATION

- A. Z-Shaped Furring Members:
 1. Erect insulation, horizontally and hold in place with Z-shaped furring members spaced 16 inches (406 mm) o.c maximum and as indicated on Drawings.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
 4. Installation Tolerance: Install each furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.04 BATT INSTALLATION

- A. Installation - General:
 1. Install insulation at locations indicated and in accordance with manufacturer's instructions.
 2. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
 3. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
 4. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- B. Metal Stud Framing: Tape insulation batts in place.

3.05 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2616
BELOW-GRADE VAPOR RETARDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vapor retarders for use below slabs-on-grade.
- B. Vapor retarder accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this Section; require attendance by all affected installers.
 - 1. Required Attendance: Contractor's quality control supervisor or superintendent, Architect, all affected trades including reinforcing subcontractor and concrete supplier, and weather barrier manufacturer.
 - 2. Discuss installation, protection, and coordination with other work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's data sheets on each product to be used, including:
 - a. Product Test Reports: For each product, for tests performed by a qualified testing agency.
 - b. Preparation instructions and recommendations.
 - c. Storage and handling requirements and recommendations.
 - d. Installation methods.
 - e. Typical Details.
 - 2. Shop Drawings: Provide typical details called out on plans and elevations.
- B. Informational Submittals:
 - 1. Sample warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than 10 years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of documented experience; approved by vapor barrier system manufacturer.
- C. Single Source Responsibility for Weather barrier: Provide and install products from single source.
- D. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- D. Protect materials during handling and installation to prevent damage.

1.06 WARRANTY

- A. Warranty: Provide written five year material warranty issued by the membrane manufacturer upon completion of work.

PART 2 PRODUCTS

2.01 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Minimum Permeance per ASTM E96/E96M: 0.04 Perms
 - 2. Water Vapor Barrier Per ASTM E1745 Meets or exceeds Class C.
 - 3. Acceptable Products:
 - a. GCP Applied Technologies; Florprufe 120.
 - b. Insulation Solutions, Inc; VIPER VAPORCHECK II 15-MIL: www.isibp.com
 - c. Poly America; Yellow Guard Vapor Barrier: www.poly-america.com
 - d. Raven Industries, Inc.; Vapor Block 15.
 - e. Reef Industries, Inc.; Griffolyn 15 mil Green.
 - f. Stego Industries, LLC; Stego Wrap 15 mil Class A.
 - g. W.R. Meadows, Inc.; Perminator 15 mil.

2.02 ACCESSORIES

- A. General: Ensure accessories are manufactured or recommended same manufacturer as vapor retarders.
- B. Tape: Manufacturer's standard tape compatible with other system components.
 - 1. Description: Black, double-sided, asphaltic, pressure-sensitive, mastic tape.
- C. Self-Adhesive Repair Tape: Manufacturer's standard tape compatible with other system components.
- D. Sealant: Manufacturer's recommended sealant.
- E. Pipe Boots: Manufacturer's standard pipe boots, factory-fabricated, sized to precisely fit diameter of each individual pipe/conduit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces and areas to receive vapor retarders. Notify Architect in writing defects of work and other unsatisfactory site conditions that would cause defective installation of vapor retarders. Do not begin installation until unacceptable conditions have been corrected.
- B. Verify site dimensions.
- C. Commencement of work will imply acceptance of substrate.

3.02 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.03 INSTALLATION

- A. Install vapor retarders in accordance with manufacturer's instructions and ASTM E1643 at concrete slabs, and as follows.
 - 1. Fine grade under slab soils to smooth and level surface prior to installation of slab on grade edge and construction joint forms.

2. Tamp and level subbase soil materials to within plus zero inches to minus 3/4 inch (19.05 mm) from required subgrade elevation.
 3. Unroll vapor barrier with longest dimension parallel with direction of pour.
 4. Lap vapor barrier up and over foundation elements and seal to foundation walls.
 5. Lap joints 2 inches (50.8 mm) minimum and seal.
 6. Seal penetrations, including pipes, with manufacturer's recommended details; no penetrations of vapor barrier membrane are permitted except for reinforcing steel and permanent utilities.
 7. Turn up sheets 12 inches (305 mm) at perimeter; at footers and vertical walls, and against penetrations. Seal joints and terminations with tape. Cut off excess material after concrete has been installed and reviewed by the Architect.
 8. Do not disturb or damage vapor barrier while placing concrete. Repair damaged vapor barrier by cutting patches of vapor barrier, overlapping damaged area 6 inches (150 mm) minimum and taping all four side with seal tape.
- B. Install vapor retarders continuously at locations as indicated on the Drawings. Ensure there are no discontinuities in vapor retarder at seams and penetrations.
- C. Install vapor retarders in largest practical widths.
- D. Ensure surface beneath vapor retarder is smooth with no sharp projections.
- E. Join sections of vapor retarder and seal penetrations in vapor retarder with seam tape. Ensure vapor retarder surfaces to receive mastic tape are clean and dry.
- F. Immediately repair holes in vapor retarder with self-adhesive repair tape.
- G. Seal around pipes and other penetrations in vapor retarder with pipe boots in accordance with manufacturer's instructions.

3.04 PROTECTION

- A. Protect vapor retarders from damage during installation of reinforcing steel and utilities and during placement of granular materials or concrete slab.
- B. Immediately repair damaged vapor retarder in accordance with manufacturer's instructions.
- C. Use only concrete dobies.
- D. Confirm membrane is free of debris prior to concrete placement.

END OF SECTION

**SECTION 07 2620
FLUID APPLIED AIR, WATER, & VAPOR BARRIER**

PART 1 - GENERAL

1.01 SUMMARY

- A. Work described in this section includes fluid applied vapor retarder and water resistive air barrier membrane system.
- B. Work includes all necessary fluid membrane materials, miscellaneous sheet goods, flashing, tapes, mastics, and sealants to ensure a complete water resistive, vapor retarding air barrier wall system including:
 - 1. Connections of wall air barrier to roof membrane.
 - 2. Connection of wall air barrier to below grade and/or foundation air barrier.
 - 3. Air barriers across construction, control, seismic and expansion joints.
 - 4. Opening and penetrations for windows, doors, vents, ducts, pipes, and curtain wall systems.
 - 5. Brick ties, bolts, and similar hardware penetrations.
 - 6. All other joints, opening, and pathways in the building wall enclosure with potential for air leakage or moisture infiltration.
- C. Related work specified elsewhere:
 - 1. Division 03: Cast-in-place concrete, precast concrete.
 - 2. Division 04: Unit masonry.
 - 3. Division 05: Steel studs, girts, and furring.
 - 4. Division 06: Gypsum sheathing, wood framing, wood sheathing, rough carpentry.
 - 5. Division 07: Flashing and sheet metal, metal wall cladding panels, thermal insulation, moisture protection, joint sealant.

1.2 DEFINITIONS

- A. American Society for Testing and Materials (ASTM):
 - 1. C794-18: Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - 2. C836-15: Standard Specification for High Solids Content, Cold Liquid Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
 - 3. C1305-16: Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane
 - 4. C1306-08(2016) e1: Standard Test Method for Hydrostatic Pressure Resistance of a Liquid-Applied Waterproofing Membrane.
 - 5. C1522-05(2013) Standard Test Method for Extensibility After Heat Aging of Cold Liquid-Applied Elastomeric Waterproofing Membranes.
 - 6. D412-16: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - 7. D1970-17a: Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 8. D2939-03: Standard Test Methods for Emulsified Bitumens Used as Protective Coatings.
 - 9. D4263-83(2012): Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 10. D4541-17: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - 11. E96-16: Standard Test Method for Vapor Transmission of Materials.

12. E783-02(2010): Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
13. E1105-15: Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.
14. E1186-17: Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
15. E2178-13: Standard Test Method for Air Permeance of Building Materials.

B. International Code Council Evaluation Services, Inc. (ICC-ES):

1. AC29: Acceptance Criteria for Cold, Liquid-applied Below-grade, Exterior Damp proofing and Waterproofing Materials.

1.3 DESIGN AND PERFORMANCE CRITERIA.

- A. General Performance: Fluid applied water resistive, vapor retarding air barrier system shall be furnished and installed without failure due to defective manufacture, application, installation, or other defects in construction.
 1. Product shall be tested in accordance with ICC-ES AC 29. ICC-ES ESR reports shall be made available upon request.
- B. Air Leakage.
 1. The fluid applied air barrier shall have less than 0.001 cfm/ft² (0.005 L/s/m²) at 1.57 psf (75 Pa) when tested in accordance with ASTM E2178.
- C. Vapor Permeance: The fluid applied air barrier shall meet the requirements of a Class II vapor retarder and shall have a vapor permeance between 0.1 and 1.0 perms (0.07 and 0.7 metric perms) when tested in accordance with ASTM E96.
- D. Physical Properties
 1. Thickness: The fluid applied water resistive air and vapor barrier shall measure a minimum of 40 mils (1.0 mm) nominal dry film thickness in accordance with the test methods of ASTM D1970.
 2. Low Temperature Flexibility: The fluid applied air barrier shall be tested in accordance with the low temperature flexibility testing of ASTM D1970 and pass at a temperature of 14.8°F (-26°C).
 3. Elongation: The fluid applied air barrier shall have a minimum elongation of 850% when tested in accordance with ASTM D412, Die C.
 4. Adhesion to Concrete: Minimum of 1.0 lb-f per inch-width (0.18 kg per cm-width) when tested in accordance with ASTM C794 under the conditions specified by ASTM C836, section 6.9.
 5. Low Temperature Crack Bridging: The fluid applied water resistive air and vapor barrier shall result in "No Cracking" when tested in accordance with ASTM C1305 as required by ASTM C836, section 6.7.
 6. Hydrostatic Pressure Resistance: The fluid applied water resistive air and vapor barrier shall have a resistance to hydrostatic pressure of 3 psi (20.7 kPa) over a 1/16-inch (1.5mm) wide crack when tested in accordance with ASTM C1306 as required by ICC-ES AC29.
 7. Resistance to Water: The fluid applied water resistive air and vapor barrier shall result in no blistering or re-emulsification when tested in accordance with ASTM D2939 as required by ICC-ES AC29.
 8. Remains in Place During Application: The fluid applied water resistive air and vapor barrier shall remain in place during application as evidenced by testing in accordance with ASTM C836, section 6.8 as is required by ICC-ES AC29.

9. Extensibility After Heat Aging: The fluid applied water resistive air and vapor barrier shall not crack when extended 1/4-inch (6mm) as per test method ASTM C1522 as is required by ICC-ES AC29.
10. VOC Content: The fluid applied air barrier shall have a maximum VOC of [50 g/l].

1.4 SUBMITTALS.

- A. General, Rainscreen Wall Assembly Components: Complete submittals shall be made jointly and simultaneously for all components of the Rainscreen wall assembly, including:
 1. Exterior wall sheathing board, if applicable;
 2. Air, water, and vapor barrier;
 3. Rainscreen wall continuous exterior insulation;
 4. Metal rainscreen wall cladding panels and sub framing components;
 5. All other trim, flashing, sealants, and components necessary for a complete rainscreen wall assembly as required by these specifications.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop drawings.
 1. Show complete rain screen wall system with air, water, and vapor barrier, continuous exterior insulation, sub framing system, metal cladding panels, ventilation components, flashings and accessories in elevation, sections, and details. Include membrane and metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations. Indicate relationships with adjacent and interfacing work.
 2. All components shall be integrated into a single comprehensive and complete shop drawing set prepared by the metal cladding system manufacturer.
 3. Shop drawings shall identify each product and component by manufacturer, product name, and thickness, size, style, or other uniquely distinguishing characteristics.
 4. Shop drawings shall be signed and sealed by a California Licensed Professional Engineer.
- D. Financial Certification: Provide the building owner with a signed and notarized (sealed) affidavit by an officer of the system supplier which confirms a current minimum corporate asset-to-liability ratio of not less than 3:1 for the supplier, or its parent corporation. Financial support information and affidavit must be dated within 30 days prior to the product submittal.
- E. Warranty: Provide unexecuted specimen warranty documents for each warranty as required in specification article 1.11.
- F. Samples.
 1. Submit three (3) samples of fluid applied, water-resistive, vapor permeable air barrier sheet, 4" x 4" minimum size.
 2. Submit samples of each system accessory, including membrane flashings, seam tapes, mastics, sealants, and any other system components or accessories depicted on shop drawings.
- G. Manufacturer Quality Standards: provide manufacturers ISO 9001 approval certificate.

- H. Manufacturers Inspections: Provide notarized statement signed by a corporate officer of the air barrier manufacturer guaranteeing the requirements listed in 3.4 FIELD QUALITY CONTROL will be provided to the owner and architect at no charge to the district.

1.5 QUALITY CRITERIA/INSTALLER QUALIFICATIONS.

- A. Engage an experienced air barrier contractor (installer) to install fluid applied, water resistive, vapor retarding air barrier system who has a minimum of three (3) years of experience specializing in the installation of air barrier systems.
- B. Air Barrier Association of America (ABAA) Quality Assurance Program.
 - 1. This project is specified to participate in the ABAA Quality Assurance Program.
 - 2. The air barrier subcontractor shall be accredited by the Air Barrier Association of America (ABAA) prior to bidding this project.
 - 3. The air barrier subcontractor must maintain at least one ABAA installer on the jobsite throughout the air barrier installation phase that is certified by the ABAA for fluid applied air barriers.
 - 4. The air barrier subcontractor shall perform daily inspections, tests, and reporting required by the ABAA Quality Assurance Program.
 - 5. The air barrier subcontractor shall coordinate, cooperate, and comply with the recommendations of the ABAA third party auditor/inspector.
- C. Successful contractor must obtain all components of the air barrier system from a single manufacturer. Any secondary products that are required which cannot be supplied by the specified manufacturer must be recommended and approved in writing by primary manufacturer prior to bidding.
- D. Air barrier subcontractor shall submit work experience and evidence of adequate financial responsibility. Architect reserves the right to inspect fabrication facilities in determining qualifications.

1.6 MOCK-UPS.

- A. Where directed by architect, construct typical exterior wall panel, 6-foot (2.8m) long by 6-foot (2.8m) wide incorporating the sheathing board or substrate, sill pan protection system, window frame and attachment method, clips, sub framing, attachment of insulation and detailing of water-resistive vapor retarding air barrier membrane application and lap seams.
- B. Mock-up Testing.
 - 1. Perform the air leakage tests and water penetration test of mock-up prior to installation of cladding and trim but after installation of all fasteners for cladding subframing and after installation of other penetrating elements.
 - 2. Air Leakage Tests: Test mock-up for air leakage location in accordance with ASTM E1186 and for air leakage quantity in accordance with ASTM E783. Use smoke tracer to locate sources of air leakage. Deficiencies shall include air leakage in excess of 0.04 cfm/ft² (0.2 L/s/m²) and unsatisfactory workmanship.
 - 3. Water Penetration: Test mock-up for water leakage in accordance with ASTM E1105. Deficiencies shall include uncontrolled water leakage and unsatisfactory workmanship.

4. Membrane Adhesion: Test mock-up of fluid applied membrane for adhesion in accordance with ASTM D 4541 using a Type 1 pull tester except that the disk used shall be 4-inches (100mm) in diameter and the membrane shall be cut through to separate the material attached to the disk from the surrounding material. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D 4541. When the air barrier material manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report shall indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, then the inspector shall simply record the value.
5. Document and correct deficiencies in mock-up and tests. Retest until satisfactory results are obtained.

1.7 DELIVERY, STORAGE, AND HANDLING.

- A. Inspect materials upon delivery.
- B. Handle materials to prevent damage.
- C. Store materials in an interior temperature-controlled environment and in their original packaging. Materials shall be stored such that a temperature in is maintained between 60°F - 80°F (15°C - 27°C) at all times.
- D. Protect stored material from direct sunlight and inclement weather until ready for use. Do not allow material to freeze or be exposed to excessive heat for direct flame.

1.8 PROJECT CONDITIONS

- A. Work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Weather Limitations.
 1. Proceed with installation of air barrier system only when existing and forecasted weather conditions permit application to be performed within the ambient air and substrate surface temperature range recommended by the supplier.
 2. Do not install fluid applied air barrier when temperatures below 20°F (-6°C) are expected within 24 hours. When temperature is below 40°F (5°C), maintain materials in climate-controlled storage space until immediately prior to use.
 3. Do not install fluid applied air barrier to damp or wet substrate.
 4. Do not install air and vapor barrier in snow, rain, fog, or mist.
- C. Field Measurements: Verify actual dimensions of construction contiguous with air barrier system by field measurements before installation.

1.9 COORDINATION

- A. Coordinate sizes and locations of windows, doors, and wall penetrations with actual equipment provided.
- B. Coordinate air barrier continuity and connections with adjacent surfaces, such as roof, foundation, and changes in wall construction.

1.10 WARRANTIES

- A. Endorse and forward to owner the following warranties:
 - 1. Manufacturer's standard material warranty in which manufacturer agrees to provide replacement material for the fluid applied water-resistive vapor retarding air barrier installed in accordance with manufacturer's instructions that fails due to material defects within three (3) years of the date of Substantial Completion.
 - 2. Installer's three (3) year warranty from date of Substantial Completion, including all components of the air and vapor barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.
 - 3. Special Rainscreen System Water Tightness Warranty: The water-resistive air barrier supplier shall provide a five (5) year warranty from date of Substantial Completion against uncontrolled water leakage to the interior of the building. The warranty shall identify by manufacturer, product name, and model number each component of the Rainscreen wall system, including each of those components listed in Article 1.5 A of this specification.
- B. Warranty provided for Air/moisture barrier, hot applied rubber asphalt waterproofing, and single ply membrane shall be provided by single manufacturer.
- C. Warranties shall commence on date of substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Air Barrier Membrane Materials.
 - 1. The basis of design shall be IntelliWrap LVB by Innovative Metals Company, Inc. (IMETCO), Norcross, GA 800-646-3826. IMETCO is a subsidiary of Garland Industries. Local Representative: Doug Clark (925) 784-6701 email: dclark@garlandind.com
 - a. OR EQUAL.
- B. General: Obtain all primary air barrier components and accessories from the same supplier to ensure total system compatibility and integrity.
 - 1. Alternate manufacturers are subject to full compliance with specification requirements, and shall be submitted for approval as follows.
 - a. Manufacturers not listed above must submit for approval, ten (10) days prior to bid date, the following: Manufacturer's literature; certification of testing in accordance with specification requirements and sections 1.4 and 1.5; sample warranties in accordance with specification section 1.11; installer qualifications in accordance with specification section 1.6, and a list of five (5) similar projects in size and scope of work.

- b. In addition to the above requirements, requests for substitute products for this section of the specification shall be accompanied by a notarized statement from a corporate officer of the Air and Water Barrier manufacturer stating that the proposed alternate air barrier product is specifically acceptable for issuance of the Special Rainscreen System Water Tightness Warranty required in Article 1.11 A 3 of this specification, which the Air and Water Barrier manufacturer is required to provide upon substantial completion of this project. This notarized statement shall identify by manufacturer, product name, and model number each component of the Rainscreen wall system, including each of those components listed in Article 1.5 A of this specification that the Air and Water Barrier manufacturer will cover under this warranty.
 - c. No substitutions will be permitted after the bid date of this project.
2. Material: Fluid applied vapor retarding single component, polymer modified, asphalt emulsion air membrane that cures to form a water resistive, vapor retardant air barrier.
 3. Application Rate/Thickness: Apply at a rate as recommended by manufacturer to achieve a minimum wet film thickness of 60 mils (1.5 mm) and cured minimum dry film thickness of 40 mils (1.0 mm).
 4. Density: 8.4 lbs/gal (0.84 kg/l); approximately 62% solids by weight.
 5. UV Exposure: 30 days maximum allowable exposure to sunlight.
 6. Application Method: Airless sprayer, roller, or brush.
 7. Application Temperature: Ambient temperature must be above 20 °F (-6 °C) and not expected to drop below stated temperature for 24 hours.
 8. Cure Time: Under normal conditions, the product shall be fully cured within 24 hours of application.
 9. VOC Content: Material shall contain no solvent, exhibit no odor, and not be subject to any VOC restrictions.
- C. Air Barrier Transition and Flashing Membrane.
1. Transition and flashing air barrier membrane shall be IntelliWrap Flashing, a self-adhering, self-sealing waterproofing tape, composed of a silver polymer film coated with an aggressive asphalt adhesive.
 2. Flashing membrane shall be used as indicated on drawings for the following applications:
 - a. Window and door jambs and head.
 - b. Through-wall flexible membrane flashings.
 - c. Transitions to foundation/below-grade, roof, and other adjacent exterior surfaces. Connect the wall flashing membrane with adjacent air barrier membrane systems according manufacturer's details, recommendations, and shop drawings.
 - d. Primary air barrier membrane reverse seam laps.
 - e. Other conditions where the primary air barrier membrane and/or flashing membranes require additional adhesion at their seams, laps, joints, edges, or ends.
 3. Roll Dimensions: 9-inches (230mm) wide by 100-ft (30.5m) long.
- D. Air Barrier Flexible Flashing and Penetration Tapes
1. Penetrations and other flashings requiring a flexible tape membrane shall use IntelliWrap FlexxBand, a flexible waterproofing tape comprised of a rubberized asphalt adhesive laminated to a cross-laminated polyethylene crepe film.
 2. Flexible flashing membrane shall be used as indicated on drawings for the following applications:

- a. Window sills and arched or round through-wall openings.
 - b. Pipe, duct, or other service penetrations.
 - c. Other flashing conditions which necessitate the use of a flexible flashing.
3. Roll Dimensions: 6-inches (150mm) wide by 50-ft (15m) long.

2.2 ACCESSORY MATERIALS

- A. Primer: For concrete, masonry, cementitious fiber board, OSB, and weathered surfaces, provide an asphalt-based commercial primer in accordance with manufacturers recommendations.
- B. Provide termination bars, sealants and other accessories as required for a complete system installation.

PART 3 - PREPERATION & EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate surfaces, and other conditions affecting performance of the Work.
- B. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by metal wall panel manufacturer. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measurements until substrate passes moisture test.
- D. Verify all surfaces are dry, sound, clean, and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the water resistive air barrier membrane and flashings. Use mastic or non-shrinking grout as recommended by air barrier manufacturer to fill voids, cracks, honeycombs, and gaps in substrate greater than 1/16-inch (6mm) in width to provide an even surface. Strike masonry joints full-flush.
- E. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with the sheathing and fastened into solid backing material. All joints in sheathing board should be taped with 2-inch (50mm) wide exterior sheathing tape prior to installation of fluid applied air barrier.
- F. Examine roughing-in for components and systems penetrating the rainscreen wall assembly to verify actual locations of penetrations.
- G. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to air barrier installation, including removing projections capable of interfering with air barrier.
- B. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through water-resistive air barrier and at protrusions.
- C. Establish straight, side and crosswise benchmarks
- D. All walls shall be checked for square and straightness. Inside and outside corners may not be plumb; set a true line for the corner flashing with string line.

- E. Ensure all preparatory work is complete prior to installing fluid applied water-resistive air barrier membrane.
- F. Minimum application temperature of fluid applied membrane and flashings to be above 20°F (-6°C), and expected to remain above said temperature for at least 24 hours. When temperature is below 40°F (5°C), maintain materials in climate controlled storage space until immediately prior to use.

3.3 AIR BARRIER INSTALLATION

- A. Vapor Retarding Air Barrier Installation: Install transition strip materials and fluid-applied vapor retarding air barrier to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and as follows, unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials:
 - 1. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
 - 2. Apply primer for fluid-applied vapor retarding air barrier as recommended by fluid-applied vapor permeable air barrier manufacturer. Based on manufacturer's recommendation, no primer may be required for the fluid-applied materials.
 - 3. Apply fluid-applied vapor retarding air barrier by airless sprayer, roller, or brush, using equipment and methods recommended by manufacturer, to achieve a dry film thickness as recommended by the manufacturer.
 - a. A two-pass application is generally recommended to ensure sufficient dry film thickness.
 - b. When applying by airless sprayer, warm the material to 100 - 130°F (38 - 55°C) immediately prior to spraying to ensure a smooth, consistent spray pattern.
 - c. Do not apply over standing water.
 - d. Allow concrete and mortar joints to cure for a minimum of 16-hours before application of fluid-applied vapor retarding air barrier.
 - 4. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under transition and flashing membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
 - 5. Do not allow materials to come in contact with chemically incompatible materials.
 - 6. Do not leave the vapor retarding air barrier exposed to sunlight for more than 30 days.
 - 7. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by manufacturer.
 - 8. At end of each working day, seal top edge of membrane to substrate with termination mastic.
- B. Window, Door, and Other Wall Openings.
 - 1. To avoid waste, predetermine best method and sequence to the install self-adhered air barrier transition and flashing membrane around window or wall openings subject to the opening size and installation of window, door or louver type.
 - 2. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches (150

mm). Secure flashing tightly into corners by working in along the sill before adhering up the jambs.

3. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place.
4. Wrap self-adhered air barrier transition and flashing membrane into wall openings to cover jambs and head. It is not required to install continuous sheets through corners.
5. Remove release film, align flashing membrane and apply pressure to ensure positive contact. Roll Lap seams to ensure adhesion. Provide lap seams to shed water.
6. Subject to window installation requirements, install preformed sill pan system and seal to installed self-adhered air barrier window flashing membrane with sealant.
7. Install windows in accordance with window manufacturer's details and cover nail flange with flashing tape. Install flashing tape along jamb and across head flanges of window and seal to installed self-adhered air barrier transition membrane. Roll tape to ensure positive contact to substrate. Seal exposed leading edge of tape.
8. For windows without nail flange, install specified aluminized tape around perimeter of opening to accommodate placement of backer rod and sealant between window frame and self-adhered air barrier transition membrane.

C. Building Transition Conditions.

1. Tie-in to structural beams, columns, floor slabs and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials with self-adhering air barrier transition and flashing membrane.
2. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll into place with roller.
3. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll seams with roller.
4. Apply fluid-applied vapor retarding air barrier and transition strips to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
5. Connect air and vapor barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors and other intersection conditions and perform sealing of penetrations, using accessory materials and in accordance with the manufacturer's recommendations.
6. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate.
7. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
8. At expansion and seismic joints provide transition to the joint assemblies.
9. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.

D. Mechanical Equipment Penetrations.

1. Mechanical pipe, electrical conduit and/or duct work must be secured solid into position prior to installation of fluid applied vapor retarding air barrier membrane.
2. Electrical services penetrating the wall assembly and fluid applied vapor retarding air barrier membrane must be placed in appropriate conduit and secured solid into position.
3. Install manufactured flanged penetration sleeves as recommended by sleeve manufacturer.

4. For straight sided penetrations, cut and fit self-adhered air barrier transition membrane to accommodate sleeve, install specified single sided flashing tape to seal the air barrier membrane to ductwork or preformed flange sleeve.
5. For pipe penetrations, refer to manufacturer's standard details.
6. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counterflashing or other procedure in accordance with manufacturer's recommendations.
7. At through-wall flashings, provide an additional 6-inch (150 mm) wide strip of manufacturer's recommended membrane counterflashing to seal top of through-wall flashing to membrane or as recommended by manufacturer. Seal exposed top edge of strip with bead of mastic or as recommended by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Air Barrier Association of America Installer Audits: Cooperate with ABAA's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
- B. Remove and replace applications of air barrier membrane system where inspections indicate that they do not comply with specified requirements.
- C. A full time employee of the manufacturer must provide job site inspections a minimum of 3 times per work week and provide detailed report to owner and architect with pictures and comments of the project progress.

3.5 PROTECTION AND CLEANING

- A. Protect wall areas covered with fluid applied water-resistive vapor retarding air barrier from damage due to construction activities, high wind conditions, and extended exposure to inclement weather.
- B. Review condition of fluid applied water-resistive vapor retarding air barrier prior to installation of exterior cladding, insulation, glazing, and fenestration products. Repair, or remove and replace damaged sections with new membrane.
- C. Recommend to cap and protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed fluid applied water-resistive vapor retarding air barrier installations.
- D. Do not allow materials to come in contact with chemically incompatible materials.
- E. Remove and replace water-resistive weather barrier membrane affected by chemical spills or surfactants.

END OF SECTION

**SECTION 07 4213
METAL WALL PANELS**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Metal panels for walls, with related flashings and accessory components.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate placement of wall panel system anchors and back-up support framing.
 2. Coordinate installation of vapor retarder and air barrier seals.
- B. Preinstallation Meeting: Convene one week before starting work of this Section.
1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 2. Require attendance by the Owner, Architect, installer and relevant sub-contractors.
 3. Include metal sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
 4. Review scheduling of wall system manufacturer's representative site inspection visits.
 5. Review submittals.
 6. Review procedures for protection of work and other construction.

1.03 SUBMITTALS

- A. Action Submittals:
1. Product Data: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
 - a. Finish manufacturer's data sheet showing physical and performance characteristics.
 - b. Storage and handling requirements and recommendations.
 - c. Fabrication instructions and recommendations.
 - d. Specimen warranty for finish, as specified herein.
 2. Shop Drawings:
 - a. Indicate dimensions, layout, joints, project specific construction details, and methods of anchorage.
 - b. Show locations and extent of metal panels on plans / elevations with detail callouts.
- B. Informational Submittals:
1. Certificate: Certify that products meet or exceed specified requirements.
 - a. Manufacturer's Project Acceptance Document: Certification that manufacturer and installer will warrant the waterproofing for the specific site, design, details, and application indicated for this project.
 - b. Installer Certification: Written document from Manufacturer stating installer is certified, approved, and licensed, or acceptable to install specified products.
 2. Manufacturer's Installation Instructions: Indicate special procedures.
 3. Structural calculations by design engineer.
 4. Samples: Submit three samples of wall panel, 12 inch (304.8 mm) x 12 inch (304.8 mm) in size illustrating finish color, sheen, and texture.
 5. Warranty:
 - a. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - b. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.
 6. Maintenance Data: Care of finishes and warranty requirements.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing the products specified in this Section with minimum 5 years of documented experience and approved by the manufacturer.
- C. Single Source Responsibility for Waterproofing: Provide and install products from single source.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000 - Quality Requirements.
- B. Mock-up: Construct mock-up of typical installation attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.
 - 1. Locate where directed by Architect.
 - 2. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefabricated material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.08 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.09 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a 10 year period after Substantial Completion:
 - 1. For degradation of panel finish, including color fading caused by exposure to weather.
 - 2. Include defects in water tightness and integrity of seals.
- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturers Metal Wall Panels - Concealed Fasteners:
 1. RHEINZINK America, Inc.; Flat Lock Tile Façade System: www.rheinzink.us.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Provide metal wall panel assemblies meeting performance requirements as determined by application of specified tests by a qualified testing agency on manufacturer's standard assemblies.
- B. Air Infiltration: Maximum 0.06 cu ft/min/sq ft (0.3 L/s/sq m) per ASTM E283 at a static-air-pressure difference of 1.57 lb./sq. ft. (75 Pa), using minimum 10 feet (3 m) by 10 feet (3 m) test panel that includes side joints.
- C. Water Penetration, No uncontrolled water penetration per ASTM E331 at a minimum static differential pressure of 6.24 pounds per square foot (300 Pa), using minimum 10 feet (3 m) by 10 feet (3 m) test panel that includes side joints.
- D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated for disengagement, per ASTM E72.
 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.
 2. Limits of Deflection: Metal wall panel assembly shall withstand scheduled wind pressure with the following allowable deflection:
 - a. Maximum allowable deflection limited to L/180 deflection of panel perimeter normal to plane of wall with no evidence of failure.
 3. Secondary Metal Framing: Design secondary metal framing for metal wall panel assembly according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 4. Side Joint Disengagement: Panels must be designed and tested under Negative load per ASTM E72.
 5. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction.

2.03 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
 1. Single-skin concealed fastener metal wall panels over wall framing.
 2. Provide exterior panels and subgirt framing assembly.
 3. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
 4. Design Pressure: In accordance with applicable codes.
 5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.

8. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.

B. Exterior Panels:

1. Ribbed-profile, exposed fastener.
2. Profile: As indicated on Drawings.
3. Material: Precoated steel sheet, 24 gage, 0.028 inch (0.71 mm) minimum thickness.
4. Panel Size: As indicated on Drawings.
5. Panel Coverage: 39 inches (996.6 mm).
6. Rib Height: 1-1/2 inches (38.10 mm).
7. Major Rib Spacing: 13 inches (330.20 mm) on center.
8. Texture: Smooth.
9. Color: As indicated on Drawings.
10. Basis of Design Product:
 - a. ATAS International, Inc; Belvedere Grand R.
 - b. Prior approved equal.

C. Exterior Panels MTL-3:

1. Flat Lock Tile: Concealed fastener.
2. Profile: As indicated on Drawings.
3. Side Seams: Double-interlocked, tight-fitting.
4. Material: Precoated aluminum sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.
5. Material: Zinc; manufacturer's standard sheet; minimum 20 gage (1.0 mm) thick.
6. Panel Size: As indicated on Drawings.
7. Texture: Smooth.

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

F. Fasteners and Anchors: Stainless steel.

2.04 MATERIALS

A. Zinc: DIN EN 988; minimum 99.99 percent Zn (Z1 according to DIN EN 1179); manufacturer's standard pre-patina sheet; color as selected from manufacturer's full line.

2.05 ACCESSORIES

A. Manufacturer's standard accessories and other items essential to completeness of standing seam wall panel.

B. Sealants: As specified in Section 07 9200 - Joint Sealants.

C. Profile Closures: Polyethylene foam, die-cut or formed to panel configuration.

D. Formed Flashing and Trim: Match material, thickness, and color of metal wall panel face sheets.

E. Fasteners: Manufacturer's standard type to suit application; stainless steel.

1. Metal-to-Metal Fasteners: Stainless steel self-drilling, self-tapping screws.
2. Washers: Neoprene.

F. Field Touch-up Paint: As recommended by panel manufacturer.

G. Provide manufacturer's factory-formed clips, shims, flashings, sealants, and tapes for a complete installation.

2.06 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements

demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Wall Substrate: Confirm that wall substrate is within tolerances acceptable to metal wall panel system manufacturer.
 - 1. Maximum deviations acceptable:
 - a. 1/4 inch (6.35 mm) in 20 feet (6 m) vertically or horizontally from face plane of framing.
 - b. 1/2 inch (12.70 mm) across building elevation.
 - c. 1/8 inch (3.17 mm) in 60 inches (1524 mm).
- C. Verify that water-resistive barrier has been installed over substrate completely and correctly.

3.02 INSTALLATION

- A. Install panels on walls and soffits in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Fasten panels to structural supports; aligned, level, and plumb.
- D. Locate joints over supports.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners unless otherwise approved by Architect.
- G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.03 ACCESSORY INSTALLATION

- A. General: Install metal wall panel accessories, provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install related flashings and sheet metal trim per requirements of Section 0762000 - Sheet Metal Flashing and Trim.
 - 2. Install components required for a complete metal wall panel assembly, including trim, copings, corners, lap strips, flashings, sealants, fillers, closure strips, and similar items.

3. Comply with performance requirements and manufacturer's written installation instructions.
4. Provide concealed fasteners except where noted on approved shop drawings.
5. Set units true to line and level as indicated.

3.04 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/8 inch (3 mm).

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written report. Correct deficiencies noted in report.

3.06 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.07 PROTECTION

- A. Protect installed panel system from damage during construction.

END OF SECTION

**SECTION 07 5420
SINGLE PLY MEMBRANE ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes an adhered Solar Bright 60 Evaloy KEE single ply roofing system.
- B. Related Work Specified Elsewhere:
 - 1. Section 06: Rough Carpentry
 - 2. Section 07: Summary of Work
 - 3. Section 07: Sheet Metal Flashing and Trim
 - 4. Section 07: Coping System

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's technical product data for each type of roofing product specified. Include data substantiating that materials comply with specified requirements.
- B. Samples: Submit two (2) samples of the following:
 - 1. Membrane
 - 2. Fasteners / Plates
 - 3. Insulation Board
- C. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.
- D. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE-7 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before work begins. Report shall be signed and sealed by a professional engineer registered in the state of CA who has provided roof system attachment analysis for not less than 5 consecutive years.
- E. Any material submitted as equal to or better than the specified material must be accompanied by a report signed and sealed by a professional engineer licensed in the state in which the installation is to take place. This report shall show that the submitted equal meets the Design and Performance criteria in this specification. Material substitutions may only be submitted by prime bidding contractors. Substitution requests submitted with a licensed engineer stamp or by non-prime bidding contractors will be rejected for non-conformance.
- F. Certificates: Cool Roofing certified by Cool Roof Rating Council.
- G. Manufacturer's Fire Compliance Certificate: Certify that the roof system furnished is approved by Factory Mutual (FM), Underwriters Laboratories (UL), Warnock Hersey (WH), or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.
- H. Shop Drawings: For roofing system. Include plans, elevations, sections, details and attachments to other Work.
- I. Samples: If specifically requested for specified products; required for alternate products.
- J. Installer Qualifications: Provide evidence that installers meet the requirements of Article 1.4.
- K. Manufacturer Qualifications and Participation:
 - 1. Provide manufacturers ISO 9001 certification and evidence of a minimum twelve years of documented experience manufacturing specified materials.

2. Provide notarized statement signed by a corporate officer of the roofing system manufacturer that all items outlined in (3.4) FIELD QUALITY CONTROL, will be provided at no charge to the owner or design professional.
- L. Closeout Submittals:
1. O & M Manuals: Maintenance instructions.
 2. Guarantee: Provide completed form per Article 1.5.
 3. Manufacturer's weekly inspection reports noting issues, corrections, and final inspection photos.

1.2. QUALITY ASSURANCE

- A. Installer Qualifications:
1. Minimum of 5 years of experience on similar work; knowledge and understanding of standards referenced herein; skill necessary to perform in compliance with this specification. Installers failing to demonstrate the required experience, knowledge, or skill shall be removed from the project.
 2. Factory trained and approved applicator.
 3. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress. Maintain proper supervision of workmen.
 4. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.
- B. Testing Characteristics: UL Class A roof; I-90 wind uplift.
- C. Applicator-Manufacturer Review: Provide Drawings and Specifications reviewed by Applicator with agent of roofing manufacturer; obtain manufacturer's agreement that specified system is proper for application shown.
- D. Manufacturers Participation:
1. Pre-Application Job-Site Conference: Arranged by Applicator, with a minimum of 1-week advance notice; for review of storage, handling, protection, surface preparation, materials and application specifications; attended by applicator, his foreman, Architect, inspector, and manufacturer's agent.
 2. When the Project is in progress, the roofing system manufacturer will provide the following:
 - a. Report progress and quality of the work as observed.
 - b. Provide job site inspections a minimum of three (3) days a week throughout the course of construction.
 - c. Provide electronic inspection reports submitted weekly to the Owner and/or Architect.
 - d. Report to the Architect and/or Owner in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
 - e. Confirm after completion that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.3. WARRANTY

- A. Manufacturer: Provide a twenty (20) year warranty on manufacturers form. Warranty shall period shall begin on date of acceptance of roofing by Owner.

- B. Manufacturer will provide the following services at years 2, 5, 10, & 15 at no cost to the owner.
 - 1. Inspection by a technical service representative and delivery of a written inspection report documenting roof conditions.
 - 2. General rooftop housekeeping, subject to limits but generally including removal of incidental debris.
- C. Provide one warranty by a single approved manufacturer for membrane roof areas, coping metal systems and transitions between the material types.
- D. Installer: Provide in required form for a period of two (2) years from date of acceptance by Owner.
- E. Warranty for Single Ply roof system, air barrier, and hot rubberized asphalt waterproofing to be provided by a single manufacturer under one warranty system.

2.PART 2 – PRODUCTS

2.1. KEE SINGLE-PLY ROOFING

- A. Acceptable Products:
 - 1. Basis of Design: Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this section.
 - 2. The design is based upon roofing systems by The Garland Company Inc./Viking Products, Local representative: Doug Clark (925) 784-6701.
 - a. Solar Bright FB 60 Membrane (ASTM D 751)
 - b. Membrane Thickness: (ASTM D 751) 60 mil nominal.
 - c. Breaking Strength (ASTM D 751): 515 lbf/in
 - d. Tearing Strength (ASTM D 751): 275 lbf/in
 - e. Factory Seam Strength (ASTM D 751) 90 lbf
 - f. Solar Reflectivity (ASTM E 903) 81%
 - g. Emissivity (ASTM E 903) 95%
- B. OR EQUAL per submittal guidelines.
- C. Parapet Wall Covering: 22 gauge, pre-painted, ANSI-SPRI ES-1 approved R-Mer Edge Coping.

2.2. UNDERLAYMENT

- A. Slip Sheet: N/A

2.3. NAILERS

- A. Douglas Fir; No. 2 or better, pressure treated; no creosote or asphalt preservatives allowed.

2.4. ROOF BOARD INSULATION

- A. Roof Insulation base layer 4' x 8' max dimension: Hunter or equal, ASTM C 1289, Type II, Class 1, Grade 2, (20psi) polyisocyanurate rigid insulation board.
 - 1. Thickness: 2"

2. R-Factor: 11"
 3. Attachment Method: Adhesive applied.
- B. Roof Insulation top layer: Georgia Pacific Dens Deck Prime Roof Board.
1. Max Dimension: 4' x 8'
 2. Thickness: ½" inch at all roof areas, 1/4" at all vertical wall areas.
 3. Attachment Method: Mechanically Attached per ASCE-7 wind uplift calculations.
- C. Tapered Insulation: Tapered roof board insulation to be used as required for tapered insulation system or tapered crickets. Hunter or equal, ASTM C 1289, Type II, Class 1, Grade 2, (20psi) polyisocyanurate insulation board.
1. Field Slope: 1/4" inch per foot.
 2. Sump Slope: 1/2" inch per foot.
 3. Cricket Slope: 1/2" inch per foot as needed for crickets and proper slope.
 4. Attachment Method: Mechanically Attached or Adhered in an approved insulation adhesive.
- D. Insulation Adhesive: Insul-Lock HR

2.5. FASTENERS

- A. Heavy duty #15 threaded fastener with a #3 Phillips drive used with barbed fastening plate to secure Mechanically Fastened Roofing Systems. It is used on minimum 22-gauge steel decks or minimum 15/32" CDX plywood decks. It is also designed to offer an optimum combination of driving performance, back-out and corrosion resistance with excellent pullout performance.
- B. Fastening Plate: A 2-3/8" diameter metal barbed fastening plate used with HP-X, CD-10 or HD 14-10 Fasteners for membrane or insulation securement. This plate can be used for membrane or insulation securement on Mechanically Fastened Roofing Systems.
- C. Insulation Fastening Plate: A nominal 3-inch metal plate used for insulation attachment in conjunction with the appropriate fastener.

2.6. ACCESSORIES

- A. Solar Bright 60 membrane shall be used for all flashing requirements to match the field membrane and warranty expectations selected for the roofing system.
- B. Solar Bright 60 Inside Corners: Pre-molded corner flashing for inside corners. 80 mil thickness. Color - White.
- C. Solar Bright Outside Corners: Pre-molded corner flashing for outside corners. 80 mil thickness. Color - White.
- D. Solar Bright T-Joint Covers: 40 mil thick non-reinforced PVC flashing cut into a 4.5-inch (114mm) diameter circle used to seal step-offs at splice intersections.
- E. Solar Bright Pipe Flashings: A pre-molded flashing and clamping ring used for pipe penetrations. Available for 1 inch to 6-inch (25 - 152mm) diameter pipes.
- F. Solar Bright Split Pipe Seals: Pre-fabricated flashing consisting of 80 mil reinforced Membrane for pipes 1 inch to 6 inch (25 - 152mm) in diameter. A split (cut) and overlap tab are incorporated to allow the pipe seal to be opened and wrapped around the pipe when it is not possible to pull a standard pipe flashing over a round penetration.
- G. Solar Bright Non-Reinforced Flashing: 80 mil thick rolls 12 inches and 24 inches wide. Used for inside/outside corners and field fabricated pipe flashings when use of pre-molded accessories is not feasible.
- H. Solar Bright Heat Weldable Walkway Rolls: offering superior tear, puncture and weather resistance and designed to protect membrane in those areas exposed to repetitive foot traffic

or other hazards. Walkway material may be heat welded to membrane using an automated heat welder or hand-held heat welder. Walkway Rolls are 36 inches (914mm) wide by 60 feet (18.3 M) long and are nominal 80 mils thick.

- I. Single ply Coated Sheet Metal: Provide where flashing, gravel stops and sheet metal are in contact with single ply roofing membrane.
- J. 100% recycled rubber Dura-Block supports for pipes, HVAC systems, ducting, Conduit, etc.

2.7. SOLVENT, SEALANT, AND ADHESIVES

- A. As recommended by manufacturer.
 - 1. KEE-Lock Foam: Two component, highly elastomeric, low-rise polyurethane foam adhesive.
 - a. Tensile Strength: 250 psi (ASTM D412)
 - b. Peel Strength: 17 lb./in. (ASTM D 903)
 - c. Flexibility: Pass @ -70 degrees F (ASTM D 816)

3. PART 3 - EXECUTION

3.1. EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- D. Do not commence Work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

- A. Do not apply wet roofing, on wet application surface, or when temperature of deck less than 50 degrees F.
- B. Provide entire roof system including treated wood nailers, Single-ply coated sheet metal, and coordination of items such as roof drains, sumps, jacks, etc.
- C. Protect adjoining materials from stains particularly around perimeter of building; prevent debris from clogging roof drains.
- D. Deck surface swept clean and dry; keep free of loose and foreign materials.

3.3. INSTALLATION

- A. Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.
 - 1. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch (6 mm). Stagger joints both horizontally and vertically if multiple layers are provided.
 - 2. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's current application guidelines and as specified in section 07 54 20, 2.4, A, B, & C above.
 - 3. Securely attach insulation to the roof deck for Adhered or Mechanically Fastened Roofing Systems. Attachment must have been successfully tested to meet or exceed

the calculated uplift pressure required by Factory Mutual (FM I-90) & the International Building Code (ASCE-7) or ANSI/SPRI WD-1.

B. Application; Adhered system over roof deck

1. Position SolarBright membrane over the acceptable substrate. Fold membrane sheet back lengthwise so half the underside of the membrane is exposed.
2. Apply KEE-Lock Foam Adhesive in accordance with the manufacturer's published instructions, to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be hot air welded over the adjoining sheet. Allow the adhesive to properly rise prior to adhering.
3. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the adhered section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.
4. Fold back the unbonded half of the sheet lengthwise and repeat the adhesive procedures.
5. Position adjoining sheets to allow a minimum overlap of 2 inches (51mm).
6. Hot-air weld the SolarBright membrane sheets using the Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's hot air welding procedures.
7. Continue to install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches (51mm) and complete the bonding procedures as stated previously.
8. Parapet Wall Covering: Install as shown, extend to full height of parapet; lap under parapet cap flashing and over wall substrate 2 inches minimum on the back side of the wall. Secure in adhesive and attach at 9" on center on the outside face to assure a completely watertight installation.
9. Walkway: Per manufacturer's instructions and as shown on drawings. If drawings do not show walkways a minimum required will be;
 - a. A path from the main roof access point to and around all HVAC units, to and around all serviceable roof top equipment, to and around all roof hatches, to and around all access points as designated by the owner, and as needed for protection of the roofing system will have walkway installed.
 - b. All support blocking will have walkway pad installed as a protection mat.

C. Fasteners:

1. General: Per manufacturer's recommendation; fastening length and pattern based on performance values supplied by the fastener/disc manufacturer and conforming to Factory Mutual I-90 fastening pattern.
2. Walkway Fastening: Provide 2-inch continuous heat weld strip around perimeter of membrane. A 3" opening is to be left non-welded at the lower side of the walkway pad to allow drainage and venting.

D. Hot Air Welding

1. All field seams exceeding 10 feet in length shall be welded with an approved automatic welder.
2. All field seams must be clean and dry prior to initiating any field welding.
3. Remove foreign materials from the seams (dirt, oils, etc.) with Acetone or authorized alternative. Use CLEAN WHITE COTTON cloths and allow approximately five minutes

for solvents to dissipate before initiating the automatic welder. **Do not use denim or synthetic rags for cleaning.**

4. All welding shall be performed only by qualified personnel to ensure the quality and continuity of the weld.
5. Contaminated areas within a seam will inhibit proper welding and will require a membrane patch or replacement of the membrane.

E. Hand Welding

1. The lap or seam area of the membrane should be intermittently tack welded to hold the membrane in place.
2. The back "interior" edge of the membrane shall be welded first, with a thin, continuous weld to concentrate heat along the exterior edge of the lap during the final welding pass.
3. The nozzle of the hand-held hot air welder shall be inserted into the lap at a 45° angle to the lap. Once the polymer on the material begins to flow, a hand roller shall be used to apply pressure at a right angle to the tip of the hand welder. Properly welded seams shall utilize a 1-1/2-inch-wide nozzle, to create a homogeneous weld, a minimum of 1-1/2 inches in width.
4. Smaller nozzles may be used for corners, and other field detailing, maintaining a minimum 1-inch weld.

F. Automatic Machine Welding

1. Follow all manufacturers' instructions for the safe operation of the automatic welder.
2. Follow local code requirements for electric supply, grounding and surge protection.
3. The use of a dedicated, portable generator is highly recommended to ensure a consistent electrical supply, without fluctuations that can interfere with weld consistency.
4. Properly welded seams shall utilize a 1-1/2-inch-wide nozzle, to create a homogeneous weld, a minimum of 1-1/2 inches in width.

G. Inspection

1. The job foreman and/or supervisor shall initiate daily inspections of all completed work which shall include, but is not limited to the probing of all field welding with a dull pointed instrument to assure the quality of the application and ensure that any equipment or operator deficiencies are immediately resolved.
2. Ensure that all aspects of the installation (sheet layout, attachment, welding, flashing details, etc.) are in strict accordance with the most current Solar Bright Roofing Systems Specifications and Details.
3. Excessive patching of field seams because of inexperienced or poor workmanship will not be accepted at time of final inspection for warranty acceptance.

H. Metal Flashings:

1. General: Fabricate and install per Section 07601 - FLASHING AND SHEET METAL, as shown and per manufacturer's recommendations. Install KEE coated metal flashing at intersections of roofs with sloped or vertical surfaces, roof interruptions and penetrations.
2. Base Flashing: Extend up vertical surfaces 6 inches, minimum, and onto the horizontal roof surfaces not less than 3 inches, unless otherwise noted. Provide KEE coated

metal flashing with 2 inches minimum overlap of roofing membrane; heat weld in the horizontal plane, with subsequent sealing of seams with sealant.

3. All perimeter edge details are to be fabricated from Garland/Viking Products SolarBright Clad Metal.
4. Ensure all fascia extend a minimum of 2 inch lower than the bottom of the wood nailers.
5. Fasten all metal flashing to wood nailers or approved substrate with approved fasteners eight (8") inches on center.
6. Manufacture and install Solar Bright Clad metal in accordance with approved details, ensuring proper attachment, maintaining 1/2 inch expansion joints and the installation of a minimum 2 inch bond breaker tape prior to sealing the joint.
7. Solidly weld Solar Bright Clad expansion joints with a 6 inch strip of Solar Bright membrane welded to the Solar Bright Clad, covering the bond breaker tape (cover plates are optional).

I. Roof Drains

1. Flash all roof drains in accordance with Solar Bright roof drain details.
2. Replace all worn or broken parts that may cut the Solar Bright membrane or prevent a watertight seal. This includes the clamping ring and strainer basket.
3. Replace all drain bolts or clamps used to hold the drain compression ring to the drain bowl.
4. Solar Bright non-reinforced 60 mil membrane shall be used for flashing the drain assembly. Drain assemblies and basins or "sumps" must be free of any asphalt or coal tar pitch residue prior to installation.
5. The drain target sheet should be sized and installed to provide for a minimum of 12 inch of exposed 60 mil on all sides of the drain.

3.4. FIELD QUALITY CONTROL

- A. Perform field inspection and testing as required under provisions of Division 01 Section Quality Requirements & manufacturers recommendations.
- B. Heat weld test cuts will be required. One (1) test cut per 5,000 square feet will be required.
- C. Correct defects or irregularities discovered during field inspection.
- D. Require attendance of roofing materials manufacturers' representatives at site during installation of the roofing system a minimum of three (3) days per week. A copy of the specification should also be on site at all times.

3.5. CLEANING

- A. Keep premises free from accumulation of waste and debris. At completion of installation remove surplus materials and debris.
- B. At completion clean exposed surfaces in a manner that will not damage finish.

3.6. FINAL INSPECTION

- A. At completion of roofing installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.
- B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

- C. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor.
- D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.
- E. Repair or replace deteriorated or defective work found at time above inspection as required to produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements
- F. Notify the Contractor, Architect, & Owner upon completion of corrections.
- G. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Sealants for joints within sheet metal fabrications.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with roofing and waterproofing work for scheduling installation of counterflashing, rain drainage and similar items related to roofing and waterproofing.
 - 2. Coordinate with the work of Section 07 9200 - Joint Sealants for installation of related sealants.
- B. Preinstallation Meeting: Convene one week minimum before starting work of this Section.
 - 1. Convene a pre-installation meeting under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Require attendance of parties directly concerned with the work of this Section, including those who are required to coordinate with the work, and those who are required to protect the work upon completion. Include the manufacturer's technical representative, Owner and Architect.
 - 3. Review approved submittals.
 - 4. Review preparation and installation procedures and coordinating and scheduling required with related work.
 - 5. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 6. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 - 7. Review requirements for insurance and certificates if applicable.
 - 8. Review sheet metal flashing observation and repair procedures after flashing installation.
- C. Sequencing: Do not proceed with installation of flashing and sheet metal work until substrate construction, cants, blocking, reglets, and other construction are ready to receive the work of this Section.

1.03 SUBMITTALS

- A. Action Submittals
 - 1. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
 - a. Product Data: Submit for each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
 - a. Include plans, elevations, sections, and attachment details. reference details to plans. elevations, and sections. Key details to plans. elevations and sections.
 - b. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - c. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - d. Include details for forming, including profiles, shapes, seams, laps, and dimensions.
 - e. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.

- f. Include details of termination points and assemblies.
 - g. Include details of roof-penetration flashing.
 - h. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 - i. Include details of special conditions.
 - j. Include details of connections to adjoining work.
 - k. Detail formed flashing and trim at scale of not less than 1-1/2 inches (38 mm) per 12 inches (305 mm).
3. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- B. Informational Submittals:
- 1. Sample warranty for finishes.
 - 2. Qualification Data: For Fabricator and Installer.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000 - Quality Requirements.
- B. Build mockup of typical roof edge, including built-in gutter and fascia, approximately 10 feet long, including supporting construction cleats, seams, attachments and accessories.
 - 1. Provide sheet metal flashing and accessories as required to meet system mock-up requirements in other Sections.
- C. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- D. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.08 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Correct defective Work within a two year period after Date of Substantial Completion. Defective work includes failure of watertightness or seals.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- E. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (50 deg C), ambient; 180 deg F (82 deg F), material surfaces.

2.02 SHEET METAL FLASHING AND TRIM ASSEMBLIES

- A. Flashing Assemblies:
 - 1. Capable of withstanding structural movement, thermally induced movement, and exposure to wind and weather without failure or permanent deformation.
 - 2. Physically protect roofing systems, roof accessories, and other building elements and systems from damage that would permit water leakage to building interior under all weather conditions.
- B. Roof Edge Flashing Assemblies:
 - 1. Pull-Off Resistance: Tested in accordance with SPRI ES-1 RE-1, RE-2, and RE-3 as applicable to positive and negative design wind pressure as defined by applicable code.
 - 2. Capable of withstanding structural movement, thermally induced movement, and exposure to wind and weather without failure or permanent deformation.
 - 3. Physically protect roofing systems, roof accessories, and other building elements and systems from damage that would permit water leakage to building interior under all weather conditions.
 - 4. Create watertight transition between adjacent waterproofing systems.

2.03 SHEET MATERIALS

- A. General: Comply with recycled content product requirements specified in Section 01 8114.
- B. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 22 gage, 0.0299 inch (0.76 mm) thick base metal, and thickness as indicated on Drawings.

1. Applications: Flashings, counterflashings, cleats and flashing assemblies not exposed to view, temporary construction, and as indicated on Drawings.

- C. Stainless Steel: ASTM A666, Type 304, soft temper, 28 gage (0.0156 inch) (0.40 mm) thick, smooth No. 4 finish.

2.04 ACCESSORIES

- A. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 2. Fasteners for Aluminum Sheet: Series 300 stainless steel.
 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Self-Adhered High Temperature Underlayment: 30 mil, cold applied, self-adhering membrane composed of a high strength polyethylene film coated on one side with a layer of butyl rubber adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the polyethylene.
1. Product:
 - a. GCP Applied Technologies; Grace Ultra.
- C. Protective Backing Paint: Asphaltic mastic, ASTM D4479 Type I.
- D. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
- E. Sealant: Specified in Section 07 9200 - Joint Sealants.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Solder: ASTM B32; Sn50 (50/50) type.
- H. Stainless steel band clamp.
- I. Solid Rivets: Made from same materials as product being inserted into.

2.05 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
1. Basis of Design Product:
 - a. Fry Reglet Corporation; MA, SM, and ST.
 - b. Other Acceptable Manufacturers:
 - 1) Hickman Company, W. P.
 - 2) Keystone Flashing Company, Inc.
 2. Material: Galvanized steel, 0.022 inch thick.
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

5. Finish: Mill.

2.06 OTHER FABRICATED SHEET METAL FLASHING AND TRIM

- A. Description:
 1. Elevator Hoistway Guards: Fabricate from at least 0.0359-inch base metal thickness (MSG 20) HDG metallic-coated steel sheet.
 2. Other Fabricated Sheet Metal Flashing and Trim: Unless otherwise indicated, comply with following:
 - a. Flashing and Trim in Contact with Soil and Elsewhere Indicated: Fabricate from at least 0.0250-inch thick (MSG 24) stainless steel sheet.
 - b. Other Flashing and Trim: Unless otherwise noted, fabricate from at least 0.0239- inch base metal thickness (MSG 24) galvanized steel sheet, or from at least 0.0250-inch thick (MSG 24) stainless steel sheet.

2.07 FABRICATION

- A. Sheet Metal Thickness/Mass:
 1. Flashing: In accordance with SMACNA Chapter 4.
 2. Gutters: In accordance with SMACNA Table 1-5.
 3. Downspouts: In accordance with SMACNA Table 1-9.
 4. Coping: In accordance with SMACNA Table 3-1.
- B. Flashing and Counter Flashing:
 1. Fabricate as indicated on Drawings and in accordance with SMACNA Architectural Sheet Metal Manual, Chapter 4.
 2. Hem exposed flashings on underside 1/2 inch (12.70 mm); miter and seam corners.
 3. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6.35 mm) and hemmed to form drip.
 4. Fabricate flashings to allow toe to extend minimum 2 inches (50.8 mm) over wall surfaces.
 5. Shop fabricate items where practicable.
 6. Obtain field measurements for accurate fit before shop fabrication
- C. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- D. Fabricate cleats and starter strips of same material as exposed sheet, one gage thickness heavier than exposed sheet, and interlockable with exposed sheet.
 1. Provide continuous cleat strips for metal copings and flashings.
- E. Form pieces in longest possible lengths.
- F. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- G. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with Solder unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
 1. Tin edges to be seamed, form seams, and solder.
 - a. Solder
 - 1) Mechanically fasten and solder and seal metal joints except those indicated or required to be expansive type joints.
 - 2) After soldering, remove flux. Wipe and wash solder joints clean.
 - 3) Do not use graphite pencils to mark metal surfaces.
- I. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, and mechanically fastened and solder.
 1. All corners, saddles, pans, etc. shall have joints w/ mechanically fastened and soldered watertight; only simple lap joints of self adhered metal may be sealed (box-cross method).

- J. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- K. Fabricate flashings to allow toe to extend minimum 4 inches (100 mm) over roofing terminations. Return and brake edges.
- L. Fabricate sheet metal saddles and collars with 4 inch minimum flanges that are mechanically fastened and soldered watertight. Return and brake edges.
- M. Formed Metal Copings: Fabricate cross joints between coping sheets with 3/16 inch (5 mm) expansion joint between sheets, and 6 inch (150 mm) wide cover plate formed to profile of coping. Form cross joints in coping according to SMACNA. Miter, seam, and seal corners of coping.
 - 1. Provide fully welded joints, except as required for expansion/contraction control.
 - 2. Provide copings in accordance with Section 13 3419 - Metal Building Systems.
- N. Provide for thermal expansion/contraction of all exposed sheet metal work exceeding 15 feet in running length, except as otherwise indicated.

2.08 GUTTER AND DOWNSPOUT FABRICATION

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96 inches (2438.40 mm) long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 - 1. Gutter Supports: Straps with finish matching the gutters.
 - 2. Expansion Joints: Lap type.
 - 3. Accessories: Wire ball downspout strainer and flat ends.
 - 4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 - a. Stainless Steel: 0.016 inch thick.
 - 5. Sealant: Shall be polyurethane or silicon based water-proofing type, compatible with aluminum gutter, downspout, and abutting dissimilar materials for intended application.
- B. Downspouts: Profile as indicated on Drawings.
 - 1. Fabricate from the following materials:
 - a. Stainless Steel: 0.016 inch thick.
- C. Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Gutters and Downspouts: Size indicated.
- E. Accessories: Profiled to suit downspouts.
 - 1. Downspout Supports: Straps.
 - a. Space downspouts 1/2 inch (12.70 mm) clear from wall surfaces.
- F. Downspout Extenders: Same material and finish as downspouts.
- G. Seal metal joints.

2.09 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. The NRCA, SMACNA, and FM Global offer recommendations for profiles, thicknesses, fastenings, and installation of low-slope roof sheet metal fabrications. Base-metal thicknesses cited for zinc-tin alloy-coated stainless-steel and copper sheets, for copper-clad stainless-steel sheet, and for zinc sheet are from manufacturer's literature.
- B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of

external leg and[drill elongated holes for fasteners on] interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: Profile as indicated on Drawings.
 - a. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
 - 1) Fabricate from the Following Materials:
 - (a) Galvanized Steel: 22 gage, 0.0299 inch (0.76 mm) thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Galvanized Steel: 22 gage, 0.0299 inch (0.76 mm).
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Galvanized Steel: 22 gage, 0.0299 inch (0.76 mm) thick.
- E. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Galvanized Steel: 22 gage, 0.0299 inch (0.76 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.03 INSTALLATION - GENERAL

- A. Comply with SMACNA Architectural Sheet Metal Manual.
- B. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
- C. Separate stainless steel work from dissimilar metals, wood and cementitious materials with approved separation material. Use bituminous coating only where high-temperature self-adhering membrane underlayment cannot be used, or is not recommended by metal manufacturer.
- D. Cleats and Edge Strips: Secure edges of sheet metal members over 12 inches (305 mm) wide, and at other indicated locations with cleats. Fasten cleats at maximum 12 inch (305 mm) on center unless otherwise indicated. Provide continuous edge strips at eaves and gable ends for attaching exposed terminating edge of copings, gravel stops, or fascias. Provide minimum 1/8 inch (3.17 mm) butt joints as required to accommodate thermal movement.
- E. Formed Metal Copings: Extend front and back edges of coping down over continuous interlocking edge strip. Terminate rear edge with hemmed and folded edge over roof base flashings, or interlock with adjacent flashings as indicated. Miter, seam, weld, and seal corners.
- F. Recessed Reglet Flashings and Counterflashings: Insert flashings full depth into recessed reglet. Anchor by mechanical means, including driven wedges of lead or other compatible metal spaced at 12 inches on center. Seal joint with elastomeric sealant specified in Section 07 9200 - Joint Sealants.

- G. Surface Mounted Reglet Flashings and Counterflashings: Place surface mounted reglet not less than 9 inches above top of finish roof surface.. Place sealant in preformed groove on back of reglet and on lap before installation. Secure reglet to wall with power driven pins through neoprene washers spaced not less than 16 inches (406.40 mm) on center. Fill top groove with elastomeric sealant specified in Section 07 9200 - Joint Sealants.
 - 1. Lap counterflashing end joints minimum 3 inches (76.20 mm). Do not solder joints. Provide continuous and soldered counterflashings at angles and corners, and lap over roof base flashings minimum 4 inches (101.6 mm), unless detailed otherwise.
- H. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for silicone sealant, extending a minimum of 4 inches (101.6 mm) over base flashing. Install stainless-steel draw band and tighten.
- I. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- J. Apply weather barrier sealant between metal flashings and self-adhesive flashings.
- K. At rainscreen drainage wall assemblies with continuous concealed air barrier, provide fully soldered collar flashings at all penetrations. Collar flashings shall have continuous, minimum 4 inches (101.6 mm) wide flanges around the penetration for integration with air barrier.
- L. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles. Extend counter flashings 4 in. minimum over roofing or waterproofing.
- M. Extend counter flashings 4 inches (101.6 mm) minimum over roofing or waterproofing.
- N. Lap joints over minimum 8 inch (203.20 mm) wide backer plate in butyl sealant bed.
- O. Lap joints over minimum 8 inches (203.20 mm) wide backer plate in butyl sealant bed.
- P. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- Q. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
 - 1. Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pre-tinned surface would show in finished Work.
 - 2. Stainless-Steel Soldering: Pre-tin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.

3.04 INSTALLATION - PRE-FINISHED SHEET METAL

- A. Take special care in the handling and installation to avoid damage to finish.
- B. Remove protective film from each unit after installation.
- C. Touch up minor damage or defects to match factory finish. Replace units which are excessively damaged as determined by Architect.

3.05 INSTALLATION - STAINLESS STEEL

- A. Separate stainless steel and copper work from dissimilar metals, wood and cementitious materials with polyethylene underlayment. Use bituminous coating only where underlayment cannot be used, or is not recommended by metal manufacturer.

3.06 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water. Overlap edges not less than 3-1/2 inch (88.90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.07 INSTALLATION - DOWNSPOUTS

- A. Install as recommended by SMACNA. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Apply bituminous paint on surfaces to be in contact with dissimilar materials.
- C. Secure downspouts to wall with 3 inch wide steel straps or concealed clamp supports, spaced not more than 8 feet oc. Fasten straps or clamps to building with non-corrosive expansion screws.
- D. At exterior EIFS surfaces, install non-corrosive expansion screws through continuous non-corrosive metal sleeve full thickness of EIFS insulation. Seal outer end of sleeve behind straps or clamps with polyurethane sealant specified in Section 07 9200 - Joint Sealants.
- E. Set splash pad under each downspout.

3.08 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 - Quality Requirements, for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.09 CLEANING AND PROTECTION

- A. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond d successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**SECTION 07 7100
ROOF SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings, fascias, and gravel stops.

1.02 PREINSTALLATION CONFERENCE: CONDUCT CONFERENCE AT PROJECT SITE.

- A. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
- B. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
- C. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.
- D. Review approved submittals.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
 - 2. Shop Drawings:
 - a. Include plans, elevations, expansion-joint locations, project specific keyed details. Distinguish between shop- and field-assembled work.
 - b. Show locations and extent of components on plans / elevations with detail callouts.
 - c. Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
 - 3. Samples: Submit two appropriately sized samples of coping and gravel stop.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.
 - 2. Installer and Manufacturer Qualifications.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) details.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 07 5400 - Thermoplastic Membrane Roofing.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 01 4000 - Quality Requirements.
 - 2. Build mockup of typical roof edge, including coping and fascia, approximately 10 feet (3.0 m) long, including supporting construction, seams, attachments, underlayment, and accessories.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.06 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
 - 1. Coordinate with installer where work is to be performed on a daily basis so that personnel, equipment, and materials below work area are properly protected.
- C. Installation shall not proceed if unusual condition is discovered or one that will preclude work to be performed in accordance with Drawings and Specifications. Contractor shall immediately report this finding to the Architect for discussion and resolution.
- D. Roofing and waterproofing surfaces shall be kept clean and free of debris.

1.07 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 5400 - Thermoplastic Membrane Roofing.

PART 2 PRODUCTS

2.01 ROOFING COMPONENTS

- A. Provide products of selected manufacturer of roof membrane as specified in Section 07 5400 - Thermoplastic Membrane Roofing.
- B. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Fascia and edge securement for roof membrane;
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Finish: 70 percent polyvinylidene fluoride.
- C. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Material: Formed steel sheet, galvanized, 24 gauge, 0.024 inch (0.6 mm) thick, minimum.
 - 4. Anchor/Support Cleats: 20 gage, 0.036 inch (0.9 mm) thick prepunched galvanized cleat with 12 inch (305 mm) wide stainless steel spring mechanically locked to cleat at 72 inches (1820 mm) on center.
 - 5. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, corners, intersections, curves, pier caps, and end caps; minimum 14 inch (355 mm) long legs on corner, intersection, and end pieces.
 - 6. Fasteners: Factory-furnished; electrolytically compatible; minimum pull out resistance of 240 pounds (109 kg) for actual substrate used; no exposed fasteners.
 - 7. Finish: 70 percent polyvinylidene fluoride.

8. Color: As indicated on drawings.
9. Basis of Design Product:
 - a. Firestone Building Products, Firestone Coping.

2.02 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Sealant: Specified in Section 07 9200 - Joint Sealants.

2.03 FINISHES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color to match Architect's sample.

2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate, areas, and conditions, with installer present.
- B. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- E. Coordinate installation of components of this Section with installation of roofing membrane and base flashings.
- F. Coordinate installation of sealants and roofing cement with work of this Section to ensure water tightness.

3.03 PROTECTION AND CLEANING

- A. Protect copings, roof edges flashings, and expansion joints from damage and wear during the remainder of the construction period.
- B. Clean over-spray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

**SECTION 07 7200
ROOF ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Curbs.
- B. Equipment rails.
- C. Roof penetrations mounting curbs.
- D. Non-penetrating pedestals.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with Section 07 5300 - Elastomeric Membrane Roofing for submittal requirements.
 - 2. Coordinate with installation of roofing system and related flashings for weather tight installation.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's data sheets on each product to be used.
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
 - d. Maintenance requirements.
 - 2. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- B. Informational Submittals:
 - 1. Certificate: For smoke hatches, provide certificate of approval from authority having jurisdiction.
 - 2. Warranty Documentation:
 - a. Submit manufacturer warranty.
 - b. Ensure that forms have been completed in Owner's name and registered with manufacturer.
 - c. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.04 REGULATORY REQUIREMENTS

- A. Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated units.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.06 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURED CURBS

- A. Acceptable Products:
1. Pate Company (The); Style PC-5.
 2. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.; Model RC-4A.
 3. Roof Products, Inc.; RPPF-2.
 4. ThyCurb; Model TC-1.
 5. Prior approved equal.
- B. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.
 2. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33 (230); G90 (Z275) coating designation; 18 gage, 0.048 inch (1.21 mm) thick.
 - a. Finish: Factory primed.
 3. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches (102 mm).
 4. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
 - a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch (152 mm) clearance between curb and metal roof panel flange allowing water to properly flow past curb.
 - b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
 - c. Maintain at least 12 inch (305 mm) clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
 - d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.
 5. Provide the layouts and configurations shown on the Drawings.
 6. Coordinate height of curbs to provide a 10 inch minimum upturn for both base and counter flashing and membrane termination.
- C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
 2. Insulate inside curbs with 1-1/2 inch (38 mm) thick fiberglass insulation.
 3. Height Above Finished Roof Surface: 10 inches (254 mm), minimum.
 4. Height Above Roof Deck: 14 inches (356 mm), minimum.

2.02 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
 2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
- B. Adjustable-Height Roller-Bearing Pipe Supports:
1. Basis-of-Design Product:

- a. B-Line, DURA-BLOK.
 - b. Prior approved equal.
 - 2. Curb Base: 100% recycled rubber and polyurethane prepolymer with a uniform load capacity of 500 pounds per linear foot of support.
 - a. Dimensions: 6-inches wide by 6-3/4 inches tall by 20 inches long.
 - 3. Steel frame: Steel, 14gage strut galvanized per ASTM A653 or 12gage strut galvanized per ASTM A653 for bridge series.
 - 4. Roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 20 diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- C. Duct Supports: with manufacturer's recommended hardware for mounting to structure or structural roof deck.
- 1. Basis-of-Design Product:
 - a. B-Line, DURA-BLOK.
 - b. Prior approved equal.
 - 2. Curb Base: 100% recycled rubber and polyurethane prepolymer with a uniform load capacity of 500 pounds per linear foot of support.
 - a. Dimensions: 6-inches wide by 6-3/4 inches tall by 42 inches long.
 - 3. Steel frame: Steel, 14gage strut galvanized per ASTM A653 or 12gage strut galvanized per ASTM A653 for bridge series.
 - 4. Roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 20 diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.
- B. Apply bituminous paint on surfaces of units in contact with cementitious materials or dissimilar metals.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

3.04 ADJUSTING

- A. Adjust hardware for smooth operation.

3.05 CLEANING

- A. Clean installed work to like-new condition.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- C. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 9113 - Exterior Painting.
- D. Clean exposed surfaces according to manufacturer's written instructions.
- E. Clean off excess sealants.
- F. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 8400**FIRESTOPPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Firestopping systems, materials, and accessories.
- B. Perimeter fire/smoke barriers.
- C. Fire-resistive joint systems.
- D. Firestopping at electrical junction boxes in fire-rated walls.
- E. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on Drawings or not, and other openings indicated.
- F. Contractor's responsibility for determining required scope of firestopping system work, and for determining applicable tested/listed systems for the entire project, and for securing jurisdictional authority approval of firestopping systems.

1.02 SYSTEM DESCRIPTION

- A. General: Make firestop and smoke seal assembly selections that comply with UL Fire Resistance Directory, authority having jurisdiction, and applicable codes for:
 - 1. Materials, fabrication, and installation of firestops and smoke seals.
 - 2. Fire containment.
 - 3. Fire resistant construction joints.
 - 4. Dynamic partition head details.
 - 5. Edge of slab and curtain wall conditions.
 - 6. Penetrations through fire-rated floors, walls, and shafts.
 - 7. Duct and damper firestops.
 - 8. Intumescent wraps and pads at receptacle boxes and recessed items within fire rated walls.
 - 9. Coordinate with mechanical and electrical to provide single manufacturer for all firestopping materials.
- B. Firestop Voids and Openings in Following Locations:
 - 1. Duct, cable, cable tray, conduit, piping, and other penetrations through floor slabs (except on-grade slabs) and through fire rated walls and partitions.
 - 2. Penetrations of vertical shafts, pipe chases, elevator shafts, and utility shafts.
 - 3. Openings between floor slab edges and exterior walls, including glass and aluminum curtain walls.
 - 4. Openings, gaps, and cracks at abutting fire rated assemblies and components, such as wall-to-wall and wall-to-floor including overhead floor and roof decks.
 - 5. Blank openings into or through fire rated floors and walls.
 - 6. Other locations indicated or scheduled.
- C. Design Requirements:
 - 1. Firestop materials used to fill floor openings in which smallest dimension is 4 inches shall support same loads that floor was designed to support. If equal floor loading capacity cannot be obtained with firestop material, provide fire rated permanent covering to support loads and traffic, capable of being removed to allow access.
 - 2. Insulated Piping and Duct Penetrations: Install firestop systems intended for use with type of insulation on penetrating item.
 - a. Install firestop systems intended for use with type of insulation on penetrating item.
 - b. If compatible firestop system is unavailable, remove insulation at contact area with firestop material

- c. Coordinate with trades who installed insulation to ensure proper re-sealing of cut edges of insulation.
- 3. Provide Products that Do Not Deteriorate when Exposed to Following Conditions:
 - a. Plumbing and Wet-Pipe Sprinkler Systems: Moisture-resistant through-penetration firestop.
 - b. Exposed to View:
 - 1) Flame-spread value of less than 25 and smoke-developed value of less than 450, ASTM E84.
 - 2) Compatible with applied finishes.
- D. F and T Rating Requirements: Conform to F and T ratings, ASTM E 814 (ANSI/UL 1479).
 - 1. Comply with applicable codes and authority having jurisdiction.
 - 2. F Ratings: Equal to fire resistance rating of assembly being penetrated but not less than one hour.
 - 3. T Ratings: Equal to F ratings or as required by authority having jurisdiction.
- E. Testing Requirements:
 - 1. Utilize systems and materials tested and approved by UL or other nationally recognized independent testing agency acceptable to authorities having jurisdiction.
 - 2. Determine fire ratings in accordance with ASTM E814 (ANSI/UL 1479) for through penetration firestops, ASTM E119 (UL263) for fire rated assemblies, and as required by applicable codes and authority having jurisdiction.
- F. Large openings may be closed with same type construction as adjacent floor, roof, and wall assembly.
- G. Sealing around penetrations fire rated assemblies without approved firestop system is not permitted. Methods and materials not permitted include but are not limited to:
 - 1. Joint compound at gypsum board assemblies.
 - 2. Mortar at masonry and concrete assemblies.
 - 3. Use of joint sealants.
- H. Whenever finished firestop materials are scheduled to receive finish paint or other coatings, test compatibility of firestop materials with coatings to be applied.

1.03 DEFINITIONS

- A. Firestopping: A material or combination of materials used to retain the integrity of fire- and smoke-rated construction by maintaining an effective barrier against the spread of flame, and to impede the passage of smoke, gases, and moisture through penetrations, blank openings, construction joints, and perimeter fire/smoke containment in or adjacent to fire-and smoke-rated wall, floor, ceiling, and other rated construction assemblies.
- B. Assembly: Particular arrangement of materials specific to type of construction described or detailed in referenced UL or other approved design.
- C. Barrier: Time-rated fire walls, smoke barrier walls, time-rated floor/ceiling assemblies, and structural floors.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is interrupted.
- E. Membrane Penetration: An opening made through one side of an assembly without passing completely through the assembly.
- F. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, top of wall and ceiling, structural floors or roof decks, and adjacent sections of structural floors.
- G. System: Specific products and applications, classified and numbered by UL or other approved testing agency to close specific barrier penetrations.

- H. Sleeve: Metal fabrication or pipe section extending through thickness of barrier used to permanently guard penetration.
- I. VOC: Volatile organic compound(s).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of firestopping systems with affected trades and adjacent work.
- B. Preinstallation Meeting: Convene one week before starting work of this Section. Notify Owner, who may request attendance by an independent consultant.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Require attendance of parties directly concerned with the work of this Section, including those who are required to coordinate with the work, and those who are required to protect the work upon completion. Include the manufacturer's technical representative.
 - 3. Review installation procedures and coordination required with related work, and conditions which could affect successful performance of the work.
 - 4. Product and classification schedule.
 - 5. Test firestop materials to confirm compatibility with adjacent materials and chemicals and solvents with which they may come into contact during construction.
- C. Sequencing: Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.
 - 1. Do not cover or conceal firestopping installations until Owner's inspection agency and jurisdictional authority have inspected each installation.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Jurisdictional Authority Submittal: Prior to submission to Architect, submit to jurisdictional authority and local fire department complete product data indicating proposed product characteristics, performance characteristics, limitation criteria, and documentation of proposed firestop materials and systems for actual project conditions.
 - a. Include manufacturer's complete installation instructions and UL Design or other approved testing agency data sheets for each proposed firestop system.
 - b. Include complete test data forms or jurisdictional acceptance for proposed assemblies not conforming to specific UL Design numbers or other approved testing agency system designs.
 - c. Submit certificate from authority having jurisdiction indicating approval of materials and systems to be used, with one complete copy, for information only, of the approved jurisdictional authority submittal.
 - 2. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
 - 3. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- B. Informational Submittal:
 - 1. Provide manufacturer's certification stating:
 - a. Each penetration of fire rated walls and floor, partition heads, and edge of slabs will be firestopped with a firestopping system tested by UL or other recognized testing agency for substrate and penetrating item.
 - b. Authorities having jurisdiction have approved firestopping systems for this project.
 - c. Products and Classifications Schedule:
 - 1) Provide tabular form schedule for firestops, fire containment, and fire resistant construction joints.
 - 2) Schedule to identify:
 - (a) Construction penetrated including fire resistance rating.

- (b) Penetrating item.
 - (c) Products and manufacturers included in each system.
 - (d) Form material used.
 - (e) Firestop classification and description from UL or other nationally recognized independent testing agency acceptable to authority having jurisdiction.
 - (f) Fire containment and fire resistant construction joint description.
 - (g) F and T ratings.
- 3) Update schedule periodically to include addition and changes.
 2. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
 3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 4. Installer's qualification statement.

1.06 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 5.504.4.1 Adhesives and sealants.
 2. 5.504.4.3 Paints and coatings.

1.07 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 1. Trained by manufacturer.
 2. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, or meeting any two of the following requirements:
 - a. With minimum 5 years documented experience installing work of this type.
 - b. Verification of at least five satisfactorily completed projects of comparable size and type.
 - c. Licensed by local authorities having jurisdiction (AHJ).
- D. Obtain firestop systems for each type and condition of penetration from a single manufacturer; intermixing of system components for each type and condition of penetration by different manufacturers is not permitted.
- E. Listed and tested assemblies and systems must be utilized, if they exist, before alternative systems requiring Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRRA) will be considered. Comply with IFC and FCIA for EJ and EFRRRA design and submittal requirements.
- F. Testing Requirements:
 1. Utilize systems and materials tested and approved by UL or other nationally recognized independent testing agency acceptable to authorities having jurisdiction.
 2. Determine fire ratings in accordance with ASTM E814 (ANSI/UL 1479) for through penetration firestops, ASTM E119 (UL263) for fire rated assemblies, and as required by applicable codes and authority having jurisdiction.

1.08 REGULATORY REQUIREMENTS

- A. Comply with execution requirements of authority having jurisdiction including, if applicable, the requirement that all firestopping work be performed by a single qualified firm or subcontractor.

1.09 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000 - Quality Requirements.
- B. Mock-up: Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
 - 2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft (1/3 linear m).
 - 3. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
 - 4. If accepted, mock-up will represent minimum standard for the work.
 - 5. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.10 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver materials in original unopened containers identified with manufacturer's brand designation and applicable UL label.
- B. Do not use damaged or expired materials.

1.11 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.12 WARRANTY

- A. Include agreement to repair or replace joint sealers which fail in joint adhesion, extrusion resistance, migration resistance, general durability, or apparent deterioration beyond manufacturer's printed limitations for stipulated warranty period from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Bio Fireshield: www.biofireshield.com.
 - 2. Hilti, Inc.: www.us.hilti.com.
 - 3. 3M Fire Protection Products: www.3m.com.
 - 4. RectorSeal: www.rectorseal.com.
 - 5. Specified Technologies, Inc.: www.stifirestop.com.

2.02 FIRESTOPPING - GENERAL REQUIREMENTS

- A. General: Use firestopping systems which are acceptable for those applications for which they are specifically designed. Use of other UL listed systems is Contractor's Option, subject to compliance with specified performance, regulatory, and quality assurance requirements.
 - 1. Fire Ratings: Refer to Drawings for required systems and ratings.

2. Where there is no specific tested and classified firestop system for an indicated condition, obtain from the firestopping system manufacturer an Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) according to IFC and FCIA.
 3. Materials, fabrication, and installation of firestops and smoke seals.
 4. Fire containment.
 5. Fire resistant construction joints.
 6. Dynamic partition head details.
 7. Edge of slab and curtain wall conditions.
 8. Penetrations through fire-rated floors, walls, and shafts.
 9. Duct and damper firestops.
 10. Intumescent wraps and pads at receptacle boxes and recessed items within fire rated walls.
 11. Coordinate with mechanical and electrical to provide single manufacturer for all firestopping materials.
- B. Large openings may be closed with same type construction as adjacent floor, roof, and wall assembly.
- C. Sealing around penetrations fire rated assemblies without approved firestop system is not permitted. Methods and materials not permitted include but are not limited to:
1. Joint compound at gypsum board assemblies.
 2. Mortar at masonry and concrete assemblies.
 3. Use of joint sealants.
- D. Whenever finished firestop materials are scheduled to receive finish paint or other coatings, test compatibility of firestop materials with coatings to be applied.
- E. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- F. Scope: Install firestopping at all locations requiring protected openings where piping, conduit, cables, sleeves, ductwork and similar items penetrate fire-resistive, fire-rated, and smoke assemblies, including but not limited to:
1. Penetrations through wall, floor, and roof assemblies, including empty openings and openings containing penetrations.
 2. Membrane penetrations where items penetrate one side of the barrier assembly.
 3. Joints between rated assemblies to allow independent movement.
 4. Perimeter barriers between exterior wall assemblies and floor and roof assemblies.
 5. Joints, through-penetrations, and membrane penetrations in smoke-rated assemblies.
- G. Materials: Comply with ASTM E814, UL 1479, and UL 2079 as applicable to achieve indicated fire ratings.
- H. General Characteristics:
1. Surface Burning: ASTM E84 and UL 723; flame spread less than 25, smoke developed less than 450.
 2. Mold Resistance: Provide firestopping materials with mold and mildew resistance rating of 0 as determined by ASTM G21.
 3. Air Leakage of Perimeter Firestopping Barriers and Penetrations: UL 2079; L-rating less than 2.0 cfm/sf or 5.0 cfm/lf as applicable to the type and location of joint.
 4. Durability and Longevity: Permanent.
 5. Side Effects During Installation: Non-toxic.
 6. Side Effects Under Fire Exposure: Non-toxic.
 7. Long Term Side Effects: None.
- I. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
1. Movement: Provide systems that have been tested to show movement capability as indicated.
 2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.

3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- J. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
1. Movement: Provide systems that have been tested to show movement capability as indicated.
- K. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
1. Movement: Provide systems that have been tested to show movement capability as indicated.
 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- L. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- M. Fire Rated Joint Systems: Integrity and indicated fire-resistance ratings as determined by UL 2079, ASTM E1399 or ASTM E1966.
- N. Fire Rated Construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces and types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- O. Smoke Barrier Construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- P. Sealant shall have a VOC content of 250 g/L or less.
- Q. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- R. Select adhesives, primers and sealants meeting CAL-Green requirements.
1. Adhesives shall meet or exceed the VOC and chemical component limits of CAL-Green Table 5.504.4.1 Adhesive VOC Limit requirements.
 2. Sealants and Sealant Primers shall meet or exceed the VOC and chemical component limits of CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 3. Current requirement refers to the date on which the materials are installed in the building.
 4. SCAQMD Rule #1168 is referenced in section 018114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
 5. Interior refers to all building construction that is inside of the exterior weatherproofing material.

2.03 MATERIALS

- A. General: Comply with regionally-sourced, adhesives and sealants, and volatile organic compound (VOC) product requirements specified in Section 018114 - Greenhouses.
- B. Firestop Mortars: Polypropylene-fiber reinforced pumpable mortar.
 - 1. 3M Brand; Fire Barrier Mortar
 - 2. Bio Fireshield; K-10+ Firestop Mortar.
 - 3. RectorSeal Corporation; Metacaulk Mortar.
- C. Putty Compound: 100 percent solids intumescent or vinyl-type formulation, free of asbestos, silicones, solvents, halogens, PCB's, and inorganic fibers; flame spread/smoke developed rating 25/25 when tested in accordance with ASTM E84; paintable, not sensitive to freezing after set.
 - 1. Product:
 - a. 3M Brand; "Fire Barrier" Moldable Putty.
 - b. 3M Brand; MPS-2 Moldable Putty Stix.
 - c. 3M Brand; MMP-4S Moldable Putty Pads.
 - d. Bio Fireshield; BIOSTOP Moldable Putty and Putty Pads.
 - e. RectorSeal Corporation; Metacaulk Putty and Putty Pads.
- D. Sealant Compound: One-part intumescent, endothermic, ablative, or elastomeric acrylic water-based calking material required by applicable UL Design; flame spread/smoke developed rating 25/25 when tested in accordance with ASTM E84.
 - 1. Product:
 - a. 3M Brand; "Fire Barrier" CP 25WB+ Caulk.
 - b. Bio Fireshield; Biotherm 100 and Biotherm™ 200 Firestop Sealants.
 - c. Bio Fireshield; BIOSTOP 500+, 750, and BF150+ Intumescent Firestop Caulks.
 - d. Metacaulk; 950, 835+, 1000, 1200, and MC150+ Intumescent Firestop Caulks.
- E. Firestopping Sealant: Silicone elastomer type; single component; non-sagging; neutral cure, re-entrable and repairable; UL classified.
 - 1. Product:
 - a. 3M Brand; "Fire Barrier" 2000+ Silicone Sealant.
- F. Wall Opening Protective Materials:
 - 1. Product:
 - a. 3M Brand; MPS-2 Moldable Putty Stix.
 - b. 3M Brand; MMP-4S Moldable Putty Pads.
 - c. Bio Fireshield; BIOSTOP Moldable Putty and Putty Pads.
 - d. RectorSeal Corporation; Metacaulk Putty and Putty Pads.
- G. Intumescent Fire Retardant Firestop Mastic:
 - 1. Product:
 - a. Bio Fireshield; 700 Firestop Mastic.
 - b. RectorSeal Corporation; Metacaulk 1100 Firestop Mastic.
- H. Non-Intumescent Firestop Spray Sealant:
 - 1. Products:
 - 2. 3M Brand; Firedam Spray.
 - 3. Bio Fireshield; BIOSTOP 750 Firestop Spray.
 - 4. RectorSeal Corporation; Metacaulk 1200 Firestop Spray.
- I. Spray-Applied Compound: Water-based, flexible coating which dries to form a flexible seal; tested in accordance with ASTM E1399, complying with wind sway and thermal category, 500 cycles at minimum 10 cycles/minute.
 - 1. Product: 3M Brand; "FireDam Spray 100.
- J. Foam Compound: Two-part, liquid-silicone elastomer formulated to foam in place when mixed; flame spread/smoke developed rating 25/25 when tested in accordance with ASTM E84.

- K. Plastic Pipe Device: Intumescent strip material, factory or site fabricated in flexible metal collar with adjustable, screw-tightened stainless steel clamp; UL classified for use with PVC, CPVC, CCPVC, CCABS, PVDF, PP, PB, and FRPP plastic pipe.
 - 1. Product:
 - a. 3M PPD.
 - b. Bio Fireshield; BIOSTOP Plastic Pipe Collar.
 - c. RectorSeal Corporation; Metacaulk Plastic Pipe Collar.

- L. Firestop Pillows.
 - 1. Products:
 - a. 3M Brand; Firestop Pillows.
 - b. Bio Fireshield, BIOSTOP Firestop PILLOWS.
 - c. RectorSeal Corporation; Metacaulk PILLOWS.

- M. Wall Opening Protective Materials.
 - 1. Products:
 - a. 3M Brand; Moldable Putty Pads.
 - b. Bio Fireshield; Firestopping Gasket.
 - c. Bio Fireshield; LECTRA-STOP Fire Rated Electrical Box Inserts
 - d. Bio Fireshield; BIOSTOP Fire Rated Putty Pads.
 - e. RectorSeal Corporation; Metacaulk BOX GUARD Fire Rated Electrical Box Inserts
 - f. RectorSeal Corporation; Metacaulk Putty Pads.
 - g. RectorSeal Corporation; Metacaulk Cover Guard.

- N. Fire Rated Joint Backing Material.
 - 1. Products:
 - a. 3M Brand; Fire Barrier Packing Material.
 - b. Bio Fireshield; BIOSTOP Joint Strips.
 - c. RectorSeal Corporation; Metacaulk Joint Strips.

- O. Composite Sheet: Composite, intumescent sheet, designed for firestopping large openings in conjunction with other firestopping components, capable of being cut to size in the field and fabricated to fit required penetration openings.
 - 1. Product:
 - a. 3M Brand; "Fire Barrier" CS-195+ Composite Sheet.
 - b. Bio Fireshield; BIOSTOP Composite Sheet.
 - c. RectorSeal Corporation; Metacaulk® Composite Sheet.

- P. Blanket Material: Refractory ceramic fiber blanket encapsulated with aluminum foil scrim complying with NFPA 96; widths and thicknesses required by applicable UL Design; specifically designed as a flexible, fireproof enclosure for kitchen exhaust ducts and fire-rated air ductwork.

- Q. Fire-Safing Insulation: ASTM C665, Type I; high-melt mineral fibers and resinous binders formed into blankets, density not less than 4.0 lbs/cu ft, tested for 3-hour fire containment for required depths and dimensions.

- R. Firestopping Pads: Intumescent, dielectric fire putty formed to 7 x 7 or 9.5 x 9.5 inch self-adhering pads, 2-hour fire rating listed by UL.
 - 1. Product:
 - a. 3M Brand; Fire Barrier Wrap/Strip FS 195.
 - b. Bio Fireshield; BIOSTOP Intumescent Wrap Strips.
 - c. RectorSeal Corporation; Metacaulk Intumescent Wrap Strips.

- S. Fire Rated Cable Pathways: Re-enterable device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill. These device modules shall be engineered such that two or more devices may be ganged together for greater capacity.
 - 1. Basis-of-Design Product:
 - a. Specified Technologies, Inc.; EZ-Path

- 1) One to Two Cables: EZ-Path Firestop Grommet.
 - 2) One to Nine Cables: EZ-Path Series 22.
 - 3) Ten or more cables: EZ-Path Series 33 and 44.
 - 4) Approved equal.
- T. Mineral Wool: 4 pcf (64 kg/m³) minimum, mineral wool batt insulation forming material cut to the shape of the fluted floor units or roof deck and toher locations required, and friction fit to completely fill the flutes above the steel straps.
1. Acceptable Products:
 - a. Hilti Construction Chemicals, Div Of Hilti Inc; Cp777 Speed Plugs.
 - b. Industrial Insulation Group L L C; Minwool-1200 Safing.
 - c. Johns Manville; Safing.
 - d. Rock Wool Manufacturing Co.; Delta Board.
 - e. Rockwool; Safe.
 - f. Thermafiber Inc; Type Saf
 - g. Approved equal.

2.04 ACCESSORIES

- A. Provide necessary accessory materials specified in UL Design to achieve complete firestop system at each penetration. Include collars, sleeves, attachment devices, intumescent materials, and other items required.
- B. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design, and as recommended by firestopping manufacturer for specific substrate surfaces.
- C. Dam Material: Mineral fiberboard, mineral fiber matting, sheet metal, alumina silicate fire board, or other permanent material required as part of the firestopping system, or removable if not specifically required as part of the firestopping system.
- D. Retainers: Impale type clips to support mineral fiber safing blankets.
- E. Foam Type: Foam backer rod.
- F. Sleeves:
 1. Steel Type: Cylindrical; gauge, seam lap, and length as required by UL system listing.
 2. Wire Mesh Type: #8 steel wire cloth fabricated from galvanized steel wire that is 0.020 inch diameter by 1/8 inch (3.17 mm) on center in both directions.
- G. Labels:
 1. Provide label for each firestop condition.
 2. Type information in non-fading ink on 20 pound (minimum) paper.
 3. Include following information on each label:
 - a. Manufacturer's name.
 - b. Product name.
 - c. Product type (sealant, putty, mortar, or other generic material description).
 - d. F-Rating.
 - e. T-Rating. State when not required for condition.
 - f. Testing and listing agency filing number, such as UL System number

2.05 CURTAIN WALL FIRE STOPPING SYSTEMS

- A. Fire Retardant Sealants and Insulation:
- B. Insulation: Approved semi-rigid curtain wall insulation and firesafing materials; coordinate with Section 07 2100 - Thermal Insulation for materials to create fire rated assembly.
- C. Smoke seal.
- D. Single component, asbestos free, neutral cure.

- E. Rated and approved for dynamic edge of slab conditions.
- F. Provide assembly that is tested and listed for use with glass and aluminum curtain wall system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Verify openings are ready to receive the work of this Section.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.
- D. Remove incompatible materials that could adversely affect bond.
- E. Install backing or damming materials required to arrest liquid material leakage.

3.03 INSTALLATION - GENERAL

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Apply firestopping materials in sufficient thicknesses to achieve scheduled fire ratings, to uniform density and texture.
- D. Install material at openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
- E. Remove dam material after firestopping material has cured only if dam material is not required as part of the firestopping system; otherwise dam material to remain permanently in place.
- F. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- G. Install labeling required by code.

3.04 INSTALLATION - FIRE SAFING INSULATION

- A. Install safing insulation to completely fill spaces between floor slab edges and spandrel construction as detailed.
- B. Install safing insulation to completely fill voids between floor and roof deck flutes and top of wall construction where wall ratings are indicated.
- C. Install and support safing insulation permanently in position to comply with tested fire assembly and applicable building code requirements.

3.05 INSTALLATION - FIRESTOPPING PADS

- A. Install firestopping pads on back side of electrical junction boxes in fire-rated walls where boxes are located in same stud space on opposite sides of same wall, and elsewhere required by jurisdictional authority and local fire department.

3.06 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone Refer toking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.
 7. Wall partitions are required to have protected openings or penetrations permanently identified with signs or stenciling. Such identification shall be located in accessible concealed floor, floor-ceiling or attic spaces:
 - a. Be repeated at intervals not exceeding 30 feet (10 m) measured horizontally along the wall or partition; and
 - b. Include lettering not less than 1/2 inch (12.70 mm) in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," also identify wall specific rating 1 HR, 2 HR etc...as indicated on architectural drawings.
 8. Include UL design number

3.07 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.
- B. Inspect installed firestopping systems according to applicable requirements of ASTM E2174 and ASTM E2393.
- C. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, "Standard Practice for On-Site Inspection of Installed Fire Stops and ASTM E2393, "Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems.
- D. Do not conceal firestops, fire containments, and fire resistant construction joints prior to required inspection.
- E. Notify authority having jurisdiction and designated inspectors of work released for inspection.
- F. Inspection Requirements:

1. Visually examine firestopping, fire containments, and fire resistant construction joints to verify compliance with Contract Documents.
2. Examine firestopping, fire containments, and fire resistant construction joints for proper installation, adhesion, and curing appropriate for each material.
3. Submit written inspection report including following information:
 - a. Identify construction penetrated including fire resistance rating.
 - b. Identify penetrating item.
 - c. Identify products and manufacturers included in each system.
 - d. Identify form material used.
 - e. Firestop classification and description from UL, FM, Warnock Hersey or other independent testing agency.
 - f. Fire containment and fire resistant construction joint description.
 - g. F and T rating.
 - h. State whether firestop, fire containment, and fire resistant construction joint is or is not in full compliance with testing agency classification, description and manufacturer's requirements. If variations occur confirm acceptance of variation by manufacturer and authority having jurisdiction.
- G. Re-examine firestopping, fire containments, and fire resistant construction joints immediately prior to concealment by other construction to ensure no damage has occurred since initial inspection.
- H. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.08 CLEANING

- A. Clean adjacent surfaces of firestopping materials.
- B. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- C. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.09 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9200

JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Convene pre-installation conference 3 weeks prior to commencing work of this Section.
- C. Conference Purpose and Agenda:
 - 1. Required Attendance: Contractor's quality control supervisor or superintendent, Architect, affected trades, and sealant manufacturer.
 - 2. Visit Project site to analyze site conditions, and inspect surfaces and joints to be sealed in order that recommendations may be made should adverse conditions exist.
 - 3. Review mock-up and field sample.
 - 4. Discuss following items:
 - a. Approved submittals.
 - b. Substrate conditions.
 - c. Preparatory work.
 - d. Weather conditions under which work will be done.
 - e. Anticipated frequency and extent of joint movement.
 - f. Joint design.
 - g. Sealant installation procedures.

1.03 SUBMITTALS

- A. Action Submittals
 - 1. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - a. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - b. List of backing materials approved for use with the specific product.
 - c. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - d. Substrates the product should not be used on.
 - e. Substrates for which use of primer is required.
 - f. Substrates for which laboratory adhesion and/or compatibility testing is required.
 - g. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - h. Sample product warranty.
 - i. Certification by manufacturer indicating that product complies with specification requirements.
 - j. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
 - k. Product test reports: For sealant, based on evaluation of comprehensive tests performed by a qualified testing agency including applicable lab testing for substrates on project.

2. Shop Drawings: In schedule form including:
 - a. Joint location and designation.
 - b. Product manufacturer, name, formulation, and color
 - c. Detailed drawings for each installation condition, including joint conditions, sealant profiles, backings, substrates, and other application related information; manufacturer's standard drawing details are acceptable if necessary information is conveyed.
3. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
4. Initial samples of cured sealants indicating full range of colors available.
5. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

B. Informational Submittals:

1. Certificate: Certify that products meet or exceed specified requirements.
 - a. Manufacturer's Project Acceptance Document: Certification that manufacturer and installer will warrant sealant for specific site, design, details, and application indicated for this project.
 - b. Installer Certification: Written document from Manufacturer stating installer is certified, approved, licensed, or acceptable to install specified products.
2. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
3. Installation Plan: Submit at least four weeks prior to start of installation.
4. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
5. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
6. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
7. Installation Log: Submit filled out log for each length or instance of sealant installed.
8. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.
9. Manufacturer and Installer qualification.
10. Warranties: Sample of special warranties.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 20 years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience and approved by manufacturer.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- E. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 1. Adhesion Testing: In accordance with ASTM C794.
 2. Compatibility Testing: In accordance with ASTM C1087.

3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
 4. Allow sufficient time for testing to avoid delaying the work.
 5. Deliver to manufacturer sufficient samples for testing.
 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility with project specific substrates.
- F. Installation Plan: Include schedule of sealed joints, including the following:
1. Joint width indicated in Contract Documents.
 2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
 3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
 4. Approximate date of installation, for evaluation of thermal movement influence.
 5. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Unique identification of each length or instance of sealant installed.
 - b. Location on project.
 - c. Substrates.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Primer to be used, or indicate as "No primer" used.
 - g. Size and actual backing material used.
 - h. Date of installation.
 - i. Name of installer.
 - j. Actual joint width; provide space to indicate maximum and minimum width.
 - k. Actual joint depth to face of backing material at centerline of joint.
 - l. Air temperature.
- G. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
 2. Name(s) of sealant manufacturers' field representatives who will be observing
 3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
 - b. Test date.
 - c. Location on project.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Test method used.
 - g. Date of installation of field sample to be tested.
 - h. Date of test.
 - i. Copy of test method documents.
 - j. Age of sealant upon date of testing.
 - k. Test results, modeled after the sample form in the test method document.
 - l. Indicate use of photographic record of test.
- H. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches (305 mm) in the first 10 linear feet (3 linear m) of joint and one test every 24 inches (610 mm) thereafter.

- b. If any failures occur in the first 10 linear feet (3 linear m), continue testing at 12 inches (305 mm) intervals at no extra cost to Owner.
 - 3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet (30 m) in the first 1000 linear feet (305 linear m), and one test per 1000 linear feet (305 linear m) thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1000 linear feet (305 linear m), continue testing at frequency of one test per 500 linear feet (152 linear m) at no extra cost to Owner.
 - 4. Field testing agency's qualifications.
 - 5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- I. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 - 6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- J. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
 - 1. Record results on Field Quality Control Log.
 - 2. Repair failed portions of joints.
- K. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
 - 1. Sample: At least 18 inches (457 mm) long.
 - 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
 - 3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
 - 4. Record results on Field Quality Control Log.
 - 5. Repair failed portions of joints.
- L. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.06 MOCKUPS

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section. Provide as many mock-ups as required until approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING.

- A. Deliver materials to Project site in original unopened containers or bundles with manufacturer's labels. Labels on delivered materials shall show manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture , temperature changes, contaminants or other causes.

1.08 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4 deg C).
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
- B. Weather Conditions: Proceed with work only when existing and forecasted weather conditions permit installation according to manufacturer's instructions and warranty requirements.

1.09 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Special Installer's Warranty: Installer agrees to repair or replace non-silicone joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Silicone Sealants: 20 years from date of Substantial Completion.
 2. Urethane Sealants: 5 years from date of Substantial Completion.
 3. Others: 2 years from date of Substantial Completion.
- D. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.
- E. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

- A. Scope:

1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Such gaps and openings in gypsum board finished stud walls and suspended ceilings.
 - 2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - c. Other joints indicated below.
2. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag non-staining silicone sealant, unless otherwise indicated.

2.02 JOINT SEALANTS - GENERAL

- A. Sealants: Only use sealants that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168, CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 1. Current requirement refers to the date on which the materials are installed in the building.
 2. A copy of SCAQMD Rule #1168 is referenced in Section 01 8114 - Greenhouses that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- B. Colors: As indicated on drawings.

2.03 NONSAG JOINT SEALANTS

- A. Type JS-5 Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT, G, A, and O.
 1. General purpose, metal to metal joints.
 2. Acceptable Products:
 - a. Dow Corning Corporation; 795.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2000 SilPruf.
 - c. Sika Corporation; Sikasil WS-295: www.usa-sika.com.
 - d. Tremco; Spectrum 2.
 - e. Prior approved equal.
- B. Type JS-3 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses NT, G, M, A and O; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Color: To be selected by Architect from manufacturer's standard range.
 5. Cure Type: Single-component, neutral moisture curing.
 6. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
 7. Acceptable Products:
 - a. Dow Corning Corporation; 756 SMS Building Sealant: www.dowcorning.com.

- b. GE Construction Sealants; Momentive Performance Materials Inc.; SilPruf NB.
 - c. Pecora Corporation; 890NST Ultra Low Modulus Architectural Silicone Sealant - Class 100: www.pecora.com.
 - d. Tremco Incorporated; Spectrem 2.
 - e. Pecora Corporation; 895NST Medium Modulus Structural Glazing & Weatherproofing Silicone Sealant - Class 50: www.pecora.com.
 - f. Sika Corporation; Sikasil WS-290: www.usa-sika.com.
 - g. Sika Corporation; Sikasil WS-295: www.usa-sika.com.
 - h. Sika Corporation; Sikasil 728NS: www.usa-sika.com.
 - i. Prior approved equal.
- C. Type JS-6 - Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus 100 percent, minus 50 percent.
 - 2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
 - 4. Cure Type: Single-component, neutral moisture curing
 - 5. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
 - 6. Acceptable Products:
 - a. Dow Corning Corporation; 758 Silicone Weather Barrier Sealant: www.dowcorning.com.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.;SSG4000 UltraGlaze.
 - c. Polymeric Systems, Inc.; PSI-631.
 - d. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
 - e. Sika Corporation; Sikasil-N Plus: www.usa-sika.com.
- D. Type JS-4 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
- 1. Color: As selected by Architect from manufacturer's full range.
 - 2. Acceptable Products:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
 - c. Pecora Corporation; 898NST Sanitary Silicone Sealant - Class 50: www.pecora.com.
 - d. Tremco Incorporated; Tremsil 200.
- E. Type JS-1 Urethane, Immersible, M, P, 25, T, NT, I: Immersible nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T, M, O. Shore A Hardness: 40 minimum, when tested in accordance with ASTM C661.
- 1. Acceptable Products:
 - a. Pecora; NR-201.
 - b. Sika Corporation; Sikaflex 15 LM SL.
 - c. Sonneborn; Sikaflex-2C SL.
 - d. Tremco; Vulkem 245.
- F. Type JS-2 Urethane, S, P, 25, T, NT: Pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T, M, O.
- 1. Acceptable Products:
 - a. BASF Building Systems; MasterSeal SL 1.
 - b. Bostik, Inc.; Chem-Calk 950.
 - c. May National Associates, Inc.; Bondaflex PUR 35 SL.
 - d. Pecora Corporation; NR-201.
 - e. Sika; Sikaflex-2C SL.
 - f. Tremco; Vulkem 245.

- G. Type JS-1 Urethane, Immersible, M, P, 25, T, NT, I: Immersible nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T, M, O. Shore A Hardness: 40 minimum, when tested in accordance with ASTM C661.
 - 1. Acceptable Products:
 - a. Pecora; NR-201.
 - b. Sika Corporation; Sikaflex 15 LM SL.
 - c. Sonneborn; Sikaflex-2C SL.
 - d. Tremco; Vulkem 245.

- H. Type JS-7 Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Acceptable Products:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.; Bondaflex Sil-A 700.
 - d. Pecora Corporation, AC-20.
 - e. Sonneborn Building Products, Sonolac.
 - f. Schnee-Morehead, Inc.; SM 8200
 - g. Tremco, Inc., Acrylic Latex Tremflex 834.

2.04 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 - a. Location: Interior.
 - 2. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 3. Closed Cell: 25 to 33 percent larger in diameter than joint width.
 - a. Location: Exterior.

- B. Bond Breaker Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
 - 1. Pressure sensitive polyethylene tape or tetrafluorethylene self-adhesive tape required by sealant manufacturer to suit application.
 - 2. Minimum Thickness of 11 mils.

- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.
 - 1. Non-staining to joint substrate beyond the substrate surface.
 - 2. Required for use unless not required by results of:
 - a. "Manufacturer's sealant-substrate compatibility and adhesion test" described under Source Quality Control.
 - b. "Field hand-pull adhesion test" under Field Quality Control.

- F. Tooling Liquids: Non-staining material approved by manufacturer to reduce adhesion of sealant to joint finishing tools.

2.05 SOURCE QUALITY CONTROL

- A. Tests:
 - 1. Coordinate testing of sealant compatibility and adhesion to:

- a. Sealant backing materials.
 - b. Metals specified in Section 07 4213 - Metal Wall Panels.
 - c. Metals specified in Section 07 4213.23 - Metal Composite Material Wall Panels.
 - d. Entrance system specified in Section 08 4313 - Aluminum-Framed Storefronts.
 - e. Curtain wall system specified in Section 08 4413 - Glazed Aluminum Curtain Walls.
 - f. Tile specified in Section 09 3000 - Tiling.
2. Manufacturer's Sealant-Substrate Compatibility and Adhesion Test:
- a. Test Methods:
 - 1) Determine if priming and other specific joint preparation techniques are not required to obtain rapid, optimum adhesion of sealants to joint substrates.
 - 2) Comply with ASTM C510, ASTM C794, and ASTM C1087.
 - b. Submit not less than 9 pieces, 3 by 5 inches in size of each type of material, including joint substrates, shims, sealant backing, and miscellaneous materials.
 - c. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.
 - d. Investigate sealant material's failing compatibility/adhesion tests and obtain manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 - e. Include in Test Report, Manufacturer's:
 - 1) Interpretation of test results regarding sealant performance.
 - 2) Primers and substrate preparation required to achieve adhesion.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Arrange for sealant manufacturer's technical representative to be present during tests.
 - 4. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- E. Provide isolation joints where necessary to prevent surface cracking of concrete topping
- F. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
 - 1. Prime joint substrates unless priming is not required by:
 - a. "Manufacturer's sealant-substrate compatibility and adhesion test" described in Source Quality Control article.
 - b. "Field hand-pull adhesion test" described in Field Quality Control article.
 - 2. Apply primer to substrate areas where joint sealant is to adhere.
 - 3. Comply with manufacturer's sequencing requirements for joint priming and sealant backing bond breaker rod installation to assure required primer application coverage and rate without placement of primer on backer rod surface to be in contact with sealant and avoid three-sided sealant adhesion.
 - 4. Do not allow spillage and migration of primer onto surfaces not to receive primer.
 - 5. Install sealant to primed substrates after primer has cured.
- E. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
 - 4. Install closed cell backings at exterior locations.
 - 5. Install open cell backings at interior locations.
- F. Install bond breaker backing tape where backer rod cannot be used.
- G. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- H. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- I. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- J. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings and according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings and according to Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

K. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

L. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

C. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

D. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet (30 linear m), notify Architect immediately.

E. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet (300 linear m), notify Architect immediately.

F. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

G. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 CLEANING AND CURING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.

3.06 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

3.08 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-1.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between plant-precast architectural concrete paving units.
 - c. Joints in stone paving units, including steps.
 - d. Tile control and expansion joints.
 - e. Joints between different materials listed above.
 - f. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces JS-2.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-3.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete, natural stone.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between different materials listed above.
 - d. Control and expansion joints in overhead surfaces.
 - e. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces JS-4.
 - 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

- b. Tile control and expansion joints in bathrooms, public restrooms, and where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: General purpose JS-5.
- 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in glass unit masonry assemblies.
 - d. Joints between metal panels.
 - e. Joints between different materials listed above.
 - f. Control and expansion joints in overhead surfaces.
 - g. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Weather barriers JS-6.
- 1. Joint Locations:
 - a. Construction joints in weather barriers.
 - b. Joints between weather barrier and other materials.
 - 2. Joint Sealant: Silicone, nonstaining, NS, M and A.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-7.
- 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors, wood trim, millwork, windows and elevator entrances.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 07 9219
ACOUSTICAL JOINT SEALANTS

PART 1 GENERAL**1.01 SUMMARY**

- A. Section includes acoustical joint sealants.

1.02 SUBMITTALS

- A. Action Submittals:
1. Product Data: For each acoustical joint sealant.
 2. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
 3. Samples for Verification: For each kind and color of acoustical joint sealant required, provide Samples with joint sealants in 1/2 inch (13 mm) wide joints formed between two 6 inch (150 mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
 4. Acoustical-Joint-Sealant Schedule: Include the following information:
 - a. Joint-sealant application, joint location, and designation.
 - b. Joint-sealant manufacturer and product name.
 - c. Joint-sealant formulation.
 - d. Joint-sealant color.
- B. Informational Submittals:
1. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by a qualified testing agency.
 2. Sample Warranties: For special warranties.

1.03 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants

1.04 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS**2.01 PERFORMANCE REQUIREMENTS**

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.
- B. VOC Content of Interior Sealants: Sealants and sealant primers shall comply with the following:
1. Acoustical sealants and sealant primers shall have a VOC content of 250 g/L or less.

- C. Sealants: Only use sealants that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168, CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. A copy of SCAQMD 1168 is referenced in Section 01 8114 - Greenhouses that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.

2.02 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed Joints Non-Rated: Manufacturer's standard nonsag, paintable, nonstaining, non-hardening latex acoustical sealant complying with ASTM C 834 Grade 0.
 - 1. Basis of Design Product:
 - a. General Electric Company; Sil Pruf, SCS 2000.
 - b. Pecora Corporation; AC-20 FTR.
 - c. Sonneborn; Sonolac.
 - d. Tremco; Tremco Acoustical Sealant .
 - e. United State Gypsum Company; SHEETROCK Acoustical Sealant.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 4. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- B. Acoustical Sealant for Exposed Joints Fire-Rated: Manufacturer's standard nonsag, paintable, nonstaining, non-hardening latex acoustical sealant complying with ASTM C 834 Grade 0.
 - 1. Basis of Design Product:
 - a. 3M; Fire Barrier 2001 Silicone RTV Foam.
 - b. HILTI ; CP 601 S Elastomeric Firestop Sealant.
 - c. Johns Manville; Firetemp CI Caulk.
 - d. Specified Technologies, Inc.; Spec Seal ES100.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 4. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.
 - 1. Products:
 - a. Pecora Corporation; AC-20 Acoustical Sealant.
 - b. Sonneborn; Sonolac.
 - c. Tremco; Acoustical Sealant.
 - d. United State Gypsum Company; USG Firecode Sound - Smoke Sealant.
- D. Acoustical Outlet Box Pads
 - 1. Minimum thickness: 1/8 inch (3.17 mm).
 - 2. Adhesion: Adheres readily to metal or plastic.
 - 3. Service Temperature: 30 degrees to 200 degrees F.
 - 4. Shall contain no asbestos.
 - 5. Acceptable Non Fire Rated Products:
 - a. Harry A. Lowry & Associates, Inc.; Lowry's Outlet Box Pads.
 - b. L.H. Dottie Co.; Sound Pad #68.

- c. Equal.
- 6. Acceptable Fire Rated Products:
 - a. 3M; Fire Barrier Moldable Putty Pads type MPP-X to fit box size.
 - b. GCP Industries; Flamesafe FSP 1077 Putty Pads.
 - c. Hilti; CP617 Putty Pads.
 - d. Nelson; Firestop Putty Pads.
 - e. RectorSeal; Metacaulk Putty Pads.
 - f. Specified Technologies Inc.; SpecSeal Firestop Putty Pads.

2.03 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. Junction boxes in partitions that include batt insulation in cavity require either acoustical outlet box pads, or fire rated outlet box pads if the partition is fire rated. Install according to manufacturer's installation instructions. The entire surface area of the junction box that is exposed within the partition cavity must be fully covered with the box pad."
- C. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths

around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

- D. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
- E. Use continuous beads of acoustical sealant to seal assemblies at the head, sill, perimeter and penetrations, and joints between layers of sound isolating gypsum board constructions

3.04 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 07 9513
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
 2. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations.
 3. Samples: Submit three samples 12 inch (305 mm) long, illustrating profile, dimension, color, and finish selected.
- B. Informational Submittals:
 1. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.
 2. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. Refer to Section 01 6000 for additional provisions.
 3. Extra Resilient Joint Filler: 10 ft (3048 mm) length and any special tools required for installation.

1.04 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Provide sample of 12 feet long indicating installation and joining of sections including corners.
 2. Locate as directed by Architect.
 3. Approved mockup may remain.

1.05 WARRANTY

- A. Special Warranty: Manufacturer and installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Failure of moving components.
 2. Verify available warranties and warranty periods for aluminum-framed entrances and storefronts.
 3. Warranty Period: Ten years from date of Substantial Completion.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Basis of Design Manufacturers:

AE3 Partners

DSA Application No. 01-119166

September 7, 2021

Increment 1

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Merritt College

Child Development Center

EXPANSION JOINT COVER ASSEMBLIES

1. Construction Specialties, Inc.: www.c-sgroup.com.
2. Other Acceptable Manufacturers:
 - a. Balco, Inc.; : www.balcousa.com.
 - b. Inpro: www.inprocorp.com.
 - c. MM Systems Corp.: www.mm-systemscorp.com.
 - d. Nystrom, Inc: www.nystrom.com.
 - e. Watson Bowman Acme Corp.;
 - f. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Floor-to-Floor:
 1. Basis of Design Product:
 - a. Construction Specialties, Inc.; RCF-300.
 2. Design Criteria:
 - a. Nominal Joint Width: 3 inches (76 mm).
 - b. Maximum Joint Width: 6 inches (156 mm).
 - c. Minimum Joint Width: 1-1/4 inches (32 mm).
 - d. Type of Movement: Seismic.
 - e. Load Capacity: Heavy duty.
 - 1) Uniform Load: 150 lb/sq. ft. (732 kg/sq. m).
 - 2) Concentrated Load: 2000 lb (907 kg).
 3. Type: Cover plate.
 - a. Cover-Plate Design: Smooth, 1/8 inch thick aluminum plate.
 - 1) Cover-Plate Recess Depth: As required to accommodate adjacent flooring.
 - b. Metal: Aluminum.
 - 1) Finish: Clear anodic, Class I.
 - c. Water Barrier: Flexible EPDM, Class I, ASTM D4637, 60 mils (1.5 mm) thick (minimum) sheet.
 - d. Fire Barrier:
 - 1) Model RFX-3F Fire Barrier - 2 hour.
 - 2) Heat Shield: Manufacturer's standard stainless steel.

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
 1. Exposed Finish Outdoors: Clear anodized.
 - a. Class II, Clear Anodic Finish: Architectural Class II, clear coating 0.010 mm or thicker, complying with AAMA 611.
- B. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168, Cal-GREEN Table 5.504.4.1 Adhesive VOC Limit, and Cal GREEN Table 5.504.4.2 Sealant VOC Limit requirements.
 1. Current requirement refers to the date on which the materials are installed in the building.
 2. A copy of SCAQMD 1168 is referenced in Section 01 8114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- C. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
 1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.
- D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.

1. Product:
 - a. Construction Specialties, Inc.; Reflex Wall Series/Model RFX.
- E. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.
- F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.04 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide anchoring devices for installation and embedding under Section 04 2600 - Single-Wythe Unit Masonry.
 1. Provide templates and rough-in measurements.
- B. Provide anchoring devices for installation .
 1. Provide templates and rough-in measurements.
- C. Prepare substrates according to expansion control system manufacturer's written instructions.
- D. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.

3.03 INSTALLATION - GENERAL

- A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.
 1. Install expansion joints true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 2. Provide for linear thermal expansion of roof expansion joint materials.
 3. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
 4. Provide uniform, neat seams.
 5. Install expansion joints to fit substrates and to result in watertight performance.
 6. Torch cutting of expansion joints is not permitted.
 7. Do not use graphite pencils to mark aluminum surfaces.
- B. Directional Changes and Other Expansion-Control Joint Systems: Coordinate installation of expansion joints with other expansion-control joint systems to result in watertight performance. Install factory-fabricated units at directional changes and at transitions between roof expansion joints and exterior expansion-control joint systems specified in Section 07 7129 - Manufactured Roof Expansion Joints to provide continuous, uninterrupted, and watertight joints.
- C. Splices: Splice expansion joints with materials provided by expansion joint manufacturer for this purpose, to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.
- D. Fire Barrier: Install fire barrier where indicated to provide continuous, uninterrupted fire resistance throughout length of roof expansion joint, including transitions and end joints.

3.04 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 5. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (76.20 mm) from each end and not more than 24 inches (610 mm) o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
1. Provide in continuous lengths for straight sections.
 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- E. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.
1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- F. Align work plumb and level, flush with adjacent surfaces.
- G. Rigidly anchor to substrate to prevent misalignment.

3.05 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- C. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

**SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Hollow metal borrowed lites glazing frames.

1.02 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SDI: Steel Door Institute.
- G. UL: Underwriters Laboratories.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with wall construction for anchor placement.
 - 2. Coordinate installation of hardware.
- B. Preinstallation Conference: Conduct conference at Project site.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
 - 2. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- B. Informational Submittals:
 - 1. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
 - 2. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
 - a. Submit manufacturer's certification that oversize fire rated assemblies conform to design, materials, and construction equivalent to requirements of individual listings for tested assemblies.

1.05 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of ANSI A250.8 - SDI-100, and as supplemented in this Section.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
 - 1. Provide hollow metal frames from SDI Certified manufacturer.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Code for fire rated assemblies.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.
- C. Inspect hollow metal products upon delivery for damage. Minor damage may be repaired provided refinishing is equal in all respects to new work and is acceptable to Architect; otherwise replace damaged items with new products as specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Amweld Building Products, Inc.: www.amweld.com.
 - 3. ASSA ABLOY, Ceco or Curries: www.assaabloydss.com.
 - 4. Pioneer Industries : www.pioneerindustries.com.
 - 5. Republic Doors, an Allegion brand: www.republicdoor.com.
 - 6. Steelcraft, an Allegion brand: www.allegion.com/us.
 - 7. Amweld Building Products, Inc.: www.amweld.com.
 - 8. Deansteel Manufacturing, Inc.: www.deansteel.com.
 - 9. Krieger Steel Products: www.kriegersteel.com.
 - 10. Approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than required in Section 01 8114 - Sustainable Design Requirements - CAL-Green.
- B. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Hinged edge square, and lock edge beveled.
 - 5. Typical Door Face Sheets: Flush.

6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on Drawings.
 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type. Where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory finished.
- B. Interior Doors, Non-Fire-Rated:
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
 2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish:
 1. Standard Hollow Metal Frames: Factory finished.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 1. Frame Metal Thickness: 14 gage, 0.067 inch (1.7 mm), minimum.
- D. Frames for Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on Drawings.
- E. Transom Bars: Fixed, of profile same as jamb and head.
- F. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- G. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 FRAME ANCHORS

- A. Frame Anchors: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M, hot-dip galvanized according to ASTM A153/A153M, Class B.
- B. Jamb Anchors:
 1. Masonry Type: Wire anchors not less than 0.177 inch thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- C. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 1. Monolithic Concrete Slabs: Adjustable-type anchors with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.07 ACCESSORIES

- A. Glazing: As specified in Section 08 8000 - Glazing.
- B. Removable Stops: Formed sheet steel, mitered corners; prepared for countersink style tamper proof screws.
- C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C476, except with a maximum slump of 4 inches (101.6 mm), as measured according to ASTM C143/C143M.
- I. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil (0.4 mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.08 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Comply with ANSI A250.8 - SDI-100.
- C. Reinforce frames wider than 48 inches (1219.20 mm) with roll formed steel channels fitted tightly into frame head, flush with top.
- D. Prepare scheduled frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side and two single silencers on frame head at double doors without mullions.
- E. Attach required fire rating label to each frame, panel and door unit.

- F. Configure exterior frames with special profile to receive snap-in weatherstripping.
- G. Prepare doors and frames for hardware in accordance with templates provided under Section 08 7100 - Door Hardware.
- H. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inches, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inch (150 mm) apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches .
 - 3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 - 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- I. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (452.70 mm) from top and bottom of frame. Space anchors not more than 32 inches (812.80 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 inches (1524 mm) to 90 inches (2286.00 mm) high.
 - 3) Five anchors per jamb from 90 inches (2286.00 mm) to 96 inches (2438.40 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438.40 mm) high.
 - 5. Head Anchors: Two anchors per head for frames more than 42 inches (1066.8 mm) wide and mounted in metal-stud partitions.
 - 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- J. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- K. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in ANSI/SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- L. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.

2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow-metal work.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
- C. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
 1. Comply with ASTM E2112 for installation of weather barrier materials in conjunction with installation of doors.
- C. Install fire rated units in accordance with NFPA 80.
- D. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

- f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
- 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
- 4. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
- 5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.58 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.58 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.58 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.58 mm), measured at jambs at floor.
- E. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.17 mm) plus or minus 1/32 inch (0.79 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.17 mm) to 1/32 inch (0.79 mm) plus or minus 1/32 inch (0.79 mm).
 - c. At Bottom of Door: 3/4 inch (19.05 mm) plus or minus 1/32 inch (0.79 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.58 mm) to 1/8 inch (3.17 mm) plus or minus 1/32 inch (0.79 mm).
- F. Glazing: Comply with installation requirements in Section 08 8000 - Glazing and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- G. Install door hardware as specified in Section 08 7100 - Door Hardware.
- H. Touch up damaged factory finishes.

3.04 ADJUSTING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.
- F. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

**SECTION 08 1416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; fire rated and non-rated.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate the work with door opening construction, door frame and door hardware installation.
 2. Coordinate installation of glazing.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
 2. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - a. Provide information as required by AWMAC/WI (NAAWS).
 3. Samples: Submit accepted manufacturer's plastic laminate selector guide.
 - a. After initial color selection, submit three samples 12 by 12 inches (305 by 305 mm) in size illustrating selected face veneers and stain color for selection, and specified finishes.
- B. Informational Submittals:
 1. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
 2. Manufacturer's Installation Instructions: Indicate special installation instructions.
 3. Warranty, executed in Owner's name.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 6. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

- 2. A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- D. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- E. Quality Certification: Provide AWI (QCP) inspection report and quality certification of completed work.
 - 1. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWI (AWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
- F. Single Source Responsibility: Furnish each type of door from one manufacturer, unless otherwise acceptable to Architect, or specified.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Code for fire rated assemblies.
- B. Fire rated assembly construction to conform to NFPA 252 and UL 10B or UL 10C.
- C. Installed Frame and Door Assemblies: Comply with NFPA 80 for fire rated class indicated.
- D. Installed Fire-rated Window Assemblies: Comply with NFPA 257 for fire rated class indicated.
- E. Installed Smoke Control Frame and Door Assemblies: Comply with NFPA 105.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.08 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 deg F (15.5 deg C) and 90 deg F (32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.35 mm) in a 42 by 84 inch (1067 by 2134 mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch (0.25 mm) in a 3 inch (76 mm) span.
 - c. Delamination in any degree.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - a. Include hanging and installation of hardware.
 3. Warranty Period for Solid-Core Interior Doors: Life of installation.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers - Wood Veneer Faced Doors:
1. Algoma Hardwoods, Inc.
 2. Graham Wood Doors: www.architectural.masonite.com.
 3. Marshfield DoorSystems, Inc.: www.marshfielddoors.com.
 4. Oskosh Door Company: oshkoshdoor.com.
 5. Oregon Door: www.oregondoor.com.
 6. VT Industries, Inc: www.vtindustries.com.
 7. Approved equal.

2.02 WOOD-BASED DOOR COMPONENTS

- A. Regional Materials: Wood doors shall be manufactured within 100 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.
- B. Certified Wood: 25 percent minimum of wood door cores shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
- C. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
- D. General: Comply with rapidly renewable material content, sustainably harvested wood, urea-formaldehyde prohibition, adhesives and sealants, and aerosol adhesives product requirements specified in Section 01 8113 - Sustainable Design Requirements - LEED.
 1. Provide core materials certified by the Forest Stewardship Council.
- E. Wood doors fabricated from old growth timber are not permitted.
- F. Provide doors manufactured with composite wood materials and components using bonding agents that contain no added urea formaldehyde resins; refer to Section 018114 - Greenhouses.
- G. Adhesives: Only use adhesives that meet or do not exceed the VOC limits of the current requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 and CAL-Green Table 5.504.4.1 Adhesive VOC Limit.
 1. Current requirement refers to the date on which the materials are installed in the building.
 2. SCAQMD Rule #1168 referenced in Section 018114 is current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
 3. Interior refers to all building construction that is inside of the exterior weatherproofing material.
 4. Comply with CAL-Green Table 5.504.4.5 - Formaldehyde Limits for composite wood and agri-fiber products.

2.03 DOORS

- A. All Doors:
 1. Quality Level - Door Type 1: Custom Grade, Extra Heavy Duty performance, in accordance with AWMAC/WI (NAAWS).
 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at all locations.
 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with ICC (IBC) - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 3. Wood veneer facing with factory transparent finish.

2.04 DOOR AND PANEL CORES

- A. General Requirement: Provide door cores fully bonded to stiles and rails.
- B. Non-Rated Solid Core and Doors: Type particleboard core (PC), plies and faces as indicated.

2.05 DOOR FACINGS

- A. Veneer Facing for Transparent Finish Door: White birch, HPVA Grade A, rotary cut, with book match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
 1. Vertical Edges: Same species as face veneer, solid wood edges, minimum 0.25 inch thick.
 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet (3 m) of each other when doors are closed.
- B. Facing Adhesive: Type II - water resistant.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores constructed with stiles and rails:
 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
 - a. Provide solid blocking for other throughbolted hardware.
 2. Provide minimum 6 inch high solid wood top rail and minimum 16 inch high solid wood bottom rail, all doors; fire-resistant treated at fire-rated doors.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
 1. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
 1. Exception: Doors to be field finished.
- F. Cut and configure exterior door edge to receive recessed weatherstripping devices.
- G. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District (SCAQMD) Rule No. 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
 - b. Flats: 50 grams per liter of product minus water.
 - c. Non-flats: 100 grams per liter of product minus water.
 - d. Non-flat High Gloss: 150 grams per liter of product minus water.
- B. Finish work in accordance with AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect from manufacturer's full range.
 - c. Sheen: Satin.
- C. Factory finish doors in accordance with approved sample.
- D. Seal door top edge with color sealer to match door facing.

2.08 ACCESSORIES

- A. Glazed Openings:
 - 1. As specified in Section 08800 Glazing and on Finish Schedule.
- B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- C. Door Hardware: As specified in Section 08 7100 - Door Hardware.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- C. Verify that opening sizes and tolerances are acceptable.
- D. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation, refer to Section 08 7100 - Door Hardware.
- B. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- C. High Pressure Decorative Laminate (HPDL) Faced Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

- D. Adjust width of non-rated doors by cutting equally on both jamb edges.
 - 1. Trim maximum of 3/4 inch (19 mm) off bottom edges.
 - 2. Trim fire-rated doors in strict compliance with fire rating limitations.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Use machine tools to cut or drill for hardware.
- G. Coordinate installation of doors with installation of frames and hardware.
- H. Coordinate installation of glazing.
- I. Install door louvers plumb and level.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.
- C. Maximum Undercut at Fire-Rated Doors: 3/4 inch (19.05 mm) clearance to non-combustible finish floor surface.

3.04 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Adjust doors for smooth and balanced door movement.
- C. Adjust closers for full closure.
- D. Restore finish on all edges of shop finished doors before installation, if fitting or machining is required on site.
- E. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

3.05 SCHEDULE

- A. Refer to Door and Frame Schedule on the Drawings.

END OF SECTION

**SECTION 08 1433
STILE AND RAIL WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood doors, stile and rail design; non-fire rated.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate the work with door opening construction, door frame and door hardware installation.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Indicate stile and rail core materials and construction; veneer species, type and characteristics.
 2. Shop Drawings: For stile and rail wood doors. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:
 - a. Dimensions of doors for factory fitting.
 - b. Locations and dimensions of mortises and holes for hardware.
 - c. Undercuts.
 - d. Doors to be factory finished and finish requirements.
 3. Samples: Submit two samples of door construction, 12 by 12 inch inch (300 by 300 mm) in size cut from top corner of door.
- B. Informational Submittals:
 1. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
 2. Manufacturer's Installation Instructions: Indicate special installation instructions.
 3. Manufacturer's qualification statement.
 4. Installer's qualification statement.
 5. Warranty, executed in Owner's name.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 5 years of documented experience.
 1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
 2. Accredited participant in specified certification program prior to commencement of fabrication and throughout duration of project.

- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Quality Certification: Provide WI (CCP) inspection report and quality certification of completed work.
 - 1. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com.
 - 2. Provide labels or certificates indicating that installed work will comply with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 deg F (15.5 deg C) and 90 deg F (32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver, and store doors in accordance with quality standard specified.
- B. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.08 WARRANTY

- A. Interior Doors: Provide manufacturer's warranty for the life of the installation.
 - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Algoma Hardwoods, Inc.; : www.algomahardwoods.com.
 - 2. Marshfield DoorSystems, Inc.: www.marshfielddoors.com.
 - 3. TruStile Doors, LLC; www.trustile.com.
 - 4. VT Industries, Inc: www.vtindustries.com.
 - 5. Approved equal.

2.02 DOORS

- A. Quality Level: Custom Grade, Standard Duty performance, in accordance with AWMAC/WI (NAAWS).
- B. Interior Doors: 1-3/4 inches (44.45 mm) thick unless otherwise indicated; solid lumber construction; mortise and tenon joints. Transparent finish where indicated on drawings.

- C. Wood veneer facing with factory opaque finish as indicated on drawings.

2.03 DOOR FACINGS

- A. Materials for Opaque Finishes: Closed-grain wood veneer or other composite material.
- B. Interior Door Adhesive: Type II - Water Resistant.
- C. Adhesives: Only use adhesives and sealants that meet or do not exceed the VOC limits of the current requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 and Cal-GREEN Table 5.504.4.1 Adhesive VOC Limits.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. SCAQMD 1168 referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green is current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.

2.04 DOOR CONSTRUCTION

- A. Vertical Exposed Edge of Stiles: Of same species as veneer facing.
- B. Fit door edge trim to edge of stiles after applying veneer facing.
- C. Bond edge banding to cores.
- D. Panel Design: As indicated on Door Schedule.
- E. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.
- F. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:
 - 1. Clearances: Provide 1/8 inch (3.17 mm) at heads, jambs, and between pairs of doors. Provide 1/2 inch (12.70 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide not more than 3/8 inch (9.53 mm) from bottom of door to top of threshold.
 - 2. Bevel non-fire-rated doors 1/8 inch (3.17 mm) in 2 inches (50.8 mm) (3-1/2 degrees) at lock and hinge edges.
- G. Glazed Openings: Trim openings indicated for glazing with solid wood moldings, with one side removable. Miter wood moldings at corner joints.
- H. Factory install glazing in doors in compliance with quality standards specified, using manufacturer's standard elastomeric glazing sealant.

2.05 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 09 9113 - Exterior Painting and Section 09 9123 - Interior Painting

2.06 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 1113.
- B. Glazed Openings:
 - 1. Fully Tempered Glass: ASTM C1048.
- C. Door Hardware: See Section 08 7100 - Door Hardware.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation, see Section 08 7100 - Door Hardware.
- B. Install doors in accordance with manufacturer's instructions and specified quality standards.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- E. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).
- F. Machine cut for hardware.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit, clearance, and joinery tolerances.
- B. Maximum Width Distortion (Cup): 1/8 inch (3.2 mm) measured with straight edge or taut string, edge to edge, over an imaginary 36 by 84 inch (915 by 2130 mm) surface area.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Operation: Rehang or replace doors that do not swing or operate freely.
- C. Adjust closers for full closure.

3.05 SCHEDULE

- A. Refer to Door and Frame Schedule on the Drawings.

END OF SECTION

**SECTION 08 3100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling mounted access units.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation with work of other trades, and obtain information on door sizes and exact locations from other trades.
 - 1. The number of access panels is to be limited as much as possible. Review and coordinated in MEP coordination meeting at beginning of construction.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
 - 2. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.
 - 2. Project Record Documents: Record actual locations of each access unit.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 6. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Manufacturers:
 - 1. Bauco Access Panel Solutions Inc: www.accesspanelsolutions.com.
 - 2. Nystrom: www.nystrom.com.
 - 3. Other Acceptable Manufacturers:
 - a. Acudor Products Inc.: www.acudor.com.
 - b. Babcock-Davis.: www.babcockdavis.com.
 - c. Bauco Access Panel Solutions Inc: www.accesspanelsolutions.com.

- d. J. L. Industries: www.jlindustries.com.
- e. Milcor by Commercial Products Group of Hart & Cooley, Inc.: www.milcorinc.com.

2.02 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Interior Walls and Ceilings, Unless Otherwise Indicated:
 - 1. Location: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Frame Thickness: 16 gage, 0.0508 inch (1.9 mm).
 - 4. Door Thickness: 14 gage, 0.079 inch (2.01 mm).
 - 5. Hinge: Continuous.
 - 6. Finish: Factory prime.
 - 7. Size:
 - a. Hand Access: 12 by 12 inches (305 by 305 mm).
 - b. Partial Body Access: 18 inch (457.20 mm) by 18 inch (457.20 mm).
 - c. Full Body Access: 24 inch (610 mm) by 24 inch (610 mm).
 - 8. Low Security Area Lock: Mortise preparation.
 - 9. Latch: Tool-operated spring or cam lock; no handle.
 - 10. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
 - 11. Finish: Powder coat.
 - a. Color: Gray.
 - 12. Acceptable Products:
 - a. Acudor Products Inc., UF-5000.
 - b. Milcor; Commercial Products Group of Hart & Cooley, Inc.; DW.
 - c. Nystrom; NT series.
- B. Fire Rated Walls and Ceilings: Refer to Drawings for fire ratings.
 - 1. Material: Steel.
 - 2. Finish: Factory prime.
 - 3. Size:
 - a. Hand Access: 12 by 12 inches (305 by 305 mm).
 - b. Partial Body Access: 18 inch (457.20 mm) by 18 inch (457.20 mm).
 - c. Full Body Access: 24 inch (610 mm) by 24 inch (610 mm).
 - 4. Hinge: Continuous.
 - 5. Insulated, double skin door panel.
 - 6. Low Security Area Lock: Mortise preparation.
 - 7. Latch: Tool-operated spring or cam lock; no handle.
 - 8. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 9. Temperature-Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
 - 10. Hardware: Spanner head cam latch, cylinder lock and key and tamper resistant screws for all exposed screws.
 - 11. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
 - 12. Finish: Powder coat.
 - a. Color: Gray.
 - 13. Acceptable Products:
 - a. Acudor Products Inc., FW-5015.
 - b. Milcor; Commercial Products Group of Hart & Cooley, Inc.; UFR.
 - c. Nystrom; IT Series.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Verify that rough openings are correctly sized and located.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.
- D. Adjust hardware and panels for proper operation.

3.04 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 3223

SLIDING AND FOLDING GLAZED WALLS AND DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Factory fabricated sliding glazed door/wall with top and bottom rails and operating hardware
 - 1. Aluminum panel frame system.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate installation with placement of vapor seal at frame perimeter.
 - 2. Coordinate installation with placement of air seal at frame perimeter.
 - 3. Coordinate installation of thermal insulation at shim spaces at frame perimeter.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this Section; require attendance by all affected installers.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide information on dimensions, frame and sill construction, glazing, and hardware.
 - 2. Test Report: Provide independent agency test report showing compliance with specified performance requirements.
 - 3. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
 - a. Submit shop drawings created by storefront manufacturer covering fabrication, installation, and finish of specified systems.
 - b. Include following:
 - 1) Fully dimensioned plans and elevations with detail coordination keys.
 - 2) Locations of exposed fasteners and joints.
 - c. Provide Detailed Drawings of:
 - 1) Composite members.
 - 2) Joint connections for framing systems and for entrance doors.
 - 3) Anchorage.
 - 4) System reinforcements.
 - 5) Drainage patterns and sill extrusions.
 - 6) Expansion and contraction provisions.
 - 7) Hardware, including locations, mounting heights, reinforcements and special installation provisions.
 - 8) Glazing methods and accessories.
 - 9) Internal sealant requirements and recommended types.
 - 10) Thermal breaks.
 - d. Schedule of finishes.
 - e. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 4. Samples: Submit three samples, 12 by 12 inch (305 by 305 mm) in size illustrating typical frame corner construction, accessories, and finishes.
 - 5. Submit three samples of door hardware.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

2. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
3. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
4. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
5. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
6. Report of field testing for water leakage.
7. Designer Qualifications Statement.
8. Manufacturer Qualifications Statement.
9. Installer Qualifications Statement.
10. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility:
 1. To ensure quality of appearance and performance, obtain materials for systems from either a single manufacturer or from manufacturer approved by systems manufacturer.
 2. Glass, glazing, and perimeter sealants for entrance and storefront systems are required as work of this Section.
- B. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- D. Installer Qualifications: Company specializing in installation of products of the type specified, with not fewer than three years of documented experience.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing of type specified in this section.
- F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- G. Certifications:
 1. Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.
 2. Submit manufacturer's certification stating that installed system is in compliance with specified requirements.

3. Submit manufacturer's certificate stating that sealed insulating glass meet or exceed specified requirements.
4. Submit coating manufacturer's certification stating fluoropolymer coating formulation is fluorosurfactant free (FSF).
5. Engineering certifications. Include statement attesting components, including frames and glass, will withstand design wind loads and that maximum allowable deflections will not be exceeded.
6. Submit certification stating acceptance of installation procedures signed by glass manufacturer, and systems manufacturer.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000.
- B. Mock-up: Provide first installed unit as mock-up including components occurring on project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
 1. Locate on-site where directed. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for installation.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.09 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a 10 year period after Date of Substantial Completion.
- C. Provide 10 year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide 10 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product - Sliding/Folding Glazed Doors/Walls:
 1. NanaWall Systems, Inc; NanaWall SL84 : www.nanawall.com.
 2. Other Acceptable Manufacturers:
 - a. Arcadia, Inc: www.arcadiainc.com.
 - b. Fleetwood Windows & Doors: www.fleetwoodusa.net
 - c. LaCantina Doors: www.lacantindoors.com
 - d. Approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: For units mounted in exterior walls and that require weather performance, provide systems that comply with the following:

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1. Structural Performance: Design to withstand design wind loads without damage or permanent set, when tested in accordance with ASTM E330/E330M.
2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
3. Air Infiltration per ASTM E283:
 - a. 0.15 cfm/ft² (0.76 L/s/m²) at a static air pressure difference of 6.24 psf (300 Pa)
4. Water Penetration per ASTM E331 and ASTM E547: No uncontrolled water leakage at a static test pressure in:
 - a. No uncontrolled water leakage at a static test pressure of 9 psf (450 Pa).

2.03 SLIDING AND FOLDING GLAZED DOORS/WALLS

- A. Aluminum Sliding/Folding Glazed Doors/Walls: Extruded aluminum sliding/folding and operable panel frames, thermally broken, factory fabricated; complete with, flashings, support and anchorage devices, and glazing.
 1. Configuration: As shown on Drawings.
 2. Support System: Floor track supported with upper guide track.
 3. Standard Sill: ADA compliant flush sill (thermally broken) with high heel protector insert, with sealant, shims and fasteners at necessary locations.
 - a. Finish: Clear anodized.
 4. Top Rail Height: 2-5/8 inch (67 mm), square edge.
 5. Vertical Stile Width: 3-7/8 inch (99 mm), square edge.
 6. Bottom Rail Height: 10 inch (254 mm), square edge.
 7. Aluminum Frames: Factory finished, thermally broken; manufacturer's standard corner construction.
 - a. Frame Depth: 3-9/16 inch (91 mm).
 - b. Head Track Width: 3-7/8 inch (99 mm) with anti-tilt feature.
 - c. Side Jamb Width: 2-13/16 inch (72 mm)
 8. Drainage: Provide drainage to exterior for moisture entering joints and glazing spaces and for condensation occurring within frame construction.
 9. Glazing Insert: Snap-in type for 1 inch infill.
 10. Glass Stops: Same material and color as frame.
 11. Aluminum Frame Finish: PVDF coating in accordance with AAMA 2605.
 - a. Color: Match windows.
 12. Basis-of-Design Product:
 - a. Nana Wall Systems, Inc.; NanaWall SL84.

2.04 FACTORY ASSEMBLY

- A. Factory assemble operable sliding and folding panel frames as single unit, including head, jambs, and bottom sections; provide concealed fasteners.
 1. Sizes: Allow for tolerances of rough framed openings, clearances, and shims at perimeter of assemblies.
 2. Joints and Corners: Flush, hairline and waterproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 3. Glazing: Factory installed.

2.05 COMPONENTS

- A. Glazing: As specified in Section 08 8000 - Glazing.
- B. Sliding/Folding Hardware: Provide manufacturer's standard hardware including carriages with sealed ball bearing rollers, and top or bottom tracks.
 1. Lower Running Carriage Carrying Capacity: 240 lb. (110 kg). Lower running carriage provided with two vertical stainless steel wheels with double ball bearings and two horizontal polyamide wheels.

2. Vertical wheels with Gothic arch feature to ride on top of stainless steel guide track covers over the full length of the sill track. Wheels riding on aluminum surfaces NOT acceptable.
 3. Upper guide carriage with two horizontal polyamide guiding wheels. For configurations with pairs of panels that can slide left or right, additional concealed, additional vertical tilt protection hardware.
 4. Hinges: Clear anodized aluminum with stainless steel security hinge pins and set-screws. Additional patent pending TwinX reinforcements between panels for a tight seal.
- C. Locking: US mortise cylinder that can accommodate 5 pin, SFIC, FSIC or LFIC cores.
 - D. Lock Cylinders: As specified in Section 08 7100 - Door Hardware.
 - E. Levers: as specified in Section 08 7100 - Door Hardware.
 - F. Weatherstripping: Manufacturer's standard, continuous and replaceable; provide between exterior doors, panels, frame and track.
 1. Hard-backed polypile weatherstrip installed in frame and interlockers and meeting stiles of bi-parting doors. Sliding panel supplied with double sweep at sill.
 - G. Anchors: Hot-dipped galvanized or stainless steel in accordance with project and manufacturer's installation requirements.
 - H. Sealant for Setting Sills and End Dams: Elastomeric sealant acceptable to door manufacturer.
 - I. Sealant and Backing Materials: As specified in Section 07 9200 - Joint Sealants.
 - J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M, Type I.

2.06 MATERIALS

- A. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 1. Current requirement refers to the date on which the materials are installed in the building.
 2. A copy of SCAQMD 1168 is referenced in Section 018114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- B. Extruded Aluminum: ASTM B221/ASTM B221M.
- C. Sheet Aluminum: ASTM B209/ASTM B209M.
- D. Structural Steel Sections: ASTM A36/A36M; shop primed.
- E. Fasteners: Stainless steel.
- F. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- G. Concealed Flashings: Stainless steel, 26 gage, 0.0187 inch (0.48 mm) minimum thickness.
- H. Perimeter Sealant: As specified in Section 07 9200 - Joint Sealants.
- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- J. Glazing and Accessories: As specified in Section - 08 8000 - Glazing.

2.07 FABRICATION

- A. Fabricate sliding/folding doors/walls in sizes indicated. Include a complete system for assembling components and anchoring doors.

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- B. Fabricate sliding/folding doors/walls that are reglazable without dismantling panel framing.
- C. Stiles and Rails: Tubular sections accurately joined, flush and hairline at corners with heavy concealed reinforcement brackets secured with machine bolts welded. Exposed screws not permitted.
- D. Prepare internal reinforcement for hardware.
- E. Weather Stripping: Provide operable panels with a double row of sliding weather stripping in horizontal rails and single- or double-row weather stripping in meeting or jamb stiles. Provide compression-type weather stripping at the perimeter of each movable panel where sliding-type weather stripping is not appropriate.
 - 1. Provide weather stripping locked into extruded grooves in door panels or frames.
- F. Submit custom hardware templates and physical hardware prior to any fabrication.

2.08 FINISHES

- A. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.
 - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil (0.023 mm); color and gloss as indicated on drawings.
 - 2. Color: Match storefront system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings are ready to receive work and opening dimensions and clearances are as indicated on Drawings.
- B. Verify that overhead structural supports are adequate and deflection is in compliance with manufacturer's installation requirements.

3.02 PREPARATION

- A. Prepare opening to permit correct installation of door unit in coordination with air and vapor seal.
- B. Apply two coats of bituminous paint with minimum of 16 mils, 0.016 inch (0.406 mm) dry film thickness (DFT), or as recommended by coating manufacturer, on concealed aluminum surfaces in contact with cementitious or dissimilar materials.
 - 1. Allow bituminous paint to dry prior to installation of aluminum component.
 - 2. Dipping of aluminum into bituminous paint is not permitted.

3.03 INSTALLATION

- A. Install assemblies in accordance with manufacturer's instructions.
- B. Install exterior doors in accordance with ASTM E2112.
- C. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- D. Use anchorage devices to securely fasten assembly to adjacent construction without distortion or imposed stresses.
- E. Set exterior sills in full bed of sealant, with end dams and non-blocking sill drainage openings.
- F. Install shims at exterior wall sill locations and ensure water dams are not created and sill weep openings are not blocked due to shim placement and orientation.

- G. Provide sealed end dams at exterior wall locations.
- H. Install perimeter sealant in accordance with requirements of Section 07 9200 - Joint Sealants.
- I. Install perimeter trim.

3.04 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation from Plumb: 1/16 inch (1.5 mm).
- C. Maximum Variation from Level: 1/16 inch (1.5 mm).
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 feet (3.05 m) straight edge.

3.05 ADJUSTING

- A. Adjust hardware for smooth operation.
- B. Lubricate hardware and moving parts.
- C. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure.
- D. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
- E. Clean aluminum surfaces immediately after installing sliding doors. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, and clean surfaces.
- F. Refinish or replace sliding storefronts with damaged finishes.
- G. Replace damaged components.

3.06 CLEANING

- A. Remove protective material from factory finished surfaces.
- B. Remove labels and visible markings.
- C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- D. Upon completion of installation, thoroughly clean door aluminum surfaces in accordance with AAMA 609 & 610.
- E. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

AE3 Partners
DSA Application No. 01-119166
September 7, 2021

Increment 1
08 3223 - 8

Merritt College
Child Development Center
SLIDING AND FOLDING GLAZED WALLS
AND DOORS

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront, with vision glass.
- B. Sun shades.
- C. Design engineering of framing system and load-bearing connections to building structural frame system.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate attachment and seal of perimeter air and vapor barrier materials.
 - 2. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this Section; require attendance by all affected installers.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.
 - 2. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - a. Submit shop drawings created by storefront manufacturer covering fabrication, installation, and finish of specified systems.
 - b. Include following:
 - 1) Fully dimensioned plans and elevations with detail coordination keys.
 - 2) Locations of exposed fasteners and joints.
 - c. Provide Detailed Drawings of:
 - 1) Composite members.
 - 2) Joint connections for framing systems and for entrance doors.
 - 3) Anchorage.
 - 4) System reinforcements.
 - 5) Drainage patterns and sill extrusions.
 - 6) Expansion and contraction provisions.
 - 7) Hardware, including locations, mounting heights, reinforcements and special installation provisions.
 - 8) Glazing methods and accessories.
 - 9) Internal sealant requirements and recommended types.
 - 10) Thermal breaks.
 - d. Schedule of finishes.
 - e. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 3. Samples: Submit three samples 12 by 12 inches (305 by 305 mm) in size illustrating finished aluminum surface, glass, glazing materials.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
 - 2. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

3. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
4. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
5. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
6. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green for the following measures:
 1. 5.504.4.1 Adhesives and sealants.
 2. 5.504.4.3 Paints and coatings.
 3. 5.504.4.3.1 Aerosol paints and coatings

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility:
 1. To ensure quality of appearance and performance, obtain materials for systems from either a single manufacturer or from manufacturer approved by systems manufacturer.
 2. Glass, glazing, and perimeter sealants for entrance and storefront systems are required as work of this Section.
- B. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- C. Installer Qualifications: Company specializing in the installation of aluminum glazing systems with minimum three years of documented experience.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- E. Certifications:
 1. Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.
 2. Submit manufacturer's certification stating that installed system is in compliance with specified requirements.
 3. Submit manufacturer's certificate stating that sealed insulating glass meet or exceed specified requirements.
 4. Submit coating manufacturer's certification stating fluoropolymer coating formulation is fluorosurfactant free (FSF).
 5. Engineering certifications. Include statement attesting components, including frames and glass, will withstand design wind loads and that maximum allowable deflections will not be exceeded.
 6. Submit certification stating acceptance of installation procedures signed by glass manufacturer, and systems manufacturer.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000 - Quality Requirements.
- B. Mock-up: Provide mock-up for integrated exterior mockup including all components occurring on project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
 - 1. Locate on-site where directed. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this Section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
- B. Failures include, but are not limited to, the following:
 - 1. Structural failures, including, but not limited to, excessive deflection.
 - 2. Noise or vibration created by wind and thermal and structural movements.
 - 3. Water penetration through fixed glazing and framing areas.
 - 4. Failure of operating components.
- C. Warranty Period: 5 years from date of Substantial Completion.
- D. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
 - 2. Glazing Position: Centered (front to back)
 - 3. Factory finish all surfaces that will be exposed in completed assemblies.
 - a. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.

- a. Fabricate individual system frame members, comp heads, sill pans, and other system components in single, continuous pieces; splices are not permitted unless specifically required by project installation conditions.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.
- B. Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
1. Manufacturer is responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
 2. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage, or moisture disposal.
 3. Requirements shown by details are intended to establish basic dimension of units, sight lines and profiles of members.
 4. Provide concealed fastening wherever possible.
 5. Provide entrance and storefront systems, including necessary modifications, to meet specified requirements and maintaining visual design concepts.
 6. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
 7. Anchors, fasteners and braces shall be structurally stressed not more than 50 percent of allowable stress when maximum loads are applied.
 8. Provide for expansion and contraction due to structural movement without detriment to appearance or performance.
 9. Assemblies shall be free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
 10. Comply with CPSC 16 CFR 1201 and ANSI Z97.1 for safety requirements of glazing materials.
 11. Anticipated Live Load Interior Beam Deflections: 1/360 of beam length.
 12. Design Wind and Seismic Loads: Comply with requirements of ASCE 7.
 13. The out-of-plane deflection limit for window wall framing supporting individual panes of glass shall be in accordance with CBC Section 2403.3 (L/175, 3/4" maximum).
 14. Out-of-Plane Deflection Limit for Window Wall Framing Supporting Multiple Panes of Glass: Design in accordance with American Architectural Manufacturers Association (AAMA) Technical Information Report (TIR) A11, "Maximum Allowable Deflection of Framing Systems for Building Cladding Components at Design Wind Loads" which prescribes design deflection limits of L/175 for a clear span "L" up to 13 feet 6 inches and L/240 + 1/4 inch for spans greater than 13 feet 6 inches, but equal to or less than 40 feet.
 15. Provide reinforced mullion sections as may be required to comply with specified design requirements, for manufacturer's specified system.

- C. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 lbf/sq ft (480 Pa), minimum.
- D. Air Leakage: Maximum of 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, when tested in accordance with ASTM E283 at 6.24 pounds per square foot (300 Pa) pressure differential across assembly.
- E. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.02 STOREFRONT SYSTEM

- A. Aluminum Framing Members SF-1: Tubular aluminum sections, drainage holes and internal weep drainage system.
 - 1. Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides
 - 3. Glazing Position:
 - a. Centered (front to back).
 - 4. Glazing Rabbet: 1 inch insulating at interior.
 - 5. Glazing Stops: Flush.
 - 6. Cross-Section: 1-3/4 inches wide by 4-1/2 inches deep (44.5 mm wide by 114.3 mm deep) nominal dimension.
 - 7. Reinforced Mullions: As required or recommended by manufacturer using manufacturer's standard profile of extruded aluminum with internal reinforcement of steel shaped structural section.
 - 8. Basis of Design Product:
 - a. Kawneer North America; Trifab VG 451 (Non-Thermal) : www.kawneer.com.
 - b. Approved equal.
- B. Aluminum Framing Members SF-2: Tubular aluminum sections, drainage holes and internal weep drainage system.
 - 1. Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Rabbet: 1 inch insulating
 - 4. Glazing Stops: Flush.
 - 5. Cross-Section: 2 wide by 6 inches deep (50.8 by 152.4 mm) nominal dimension.
 - 6. Reinforced Mullions: As required or recommended by manufacturer using manufacturer's standard profile of extruded aluminum with internal reinforcement of steel shaped structural section.
 - 7. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - 8. Basis of Design Product:
 - 9. Kawneer North America; 601T Thermal Framing System: www.kawneer.com.
- C. Aluminum Framing Members SF-3: Tubular aluminum sections, drainage holes and internal weep drainage system.
 - 1. Construction: Nonthermal.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Rabbet: 1/4 inch monolithic
 - 4. Glazing Stops: Flush.
 - 5. Cross-Section: 2 wide by 6 inches deep (50.8 by 152.4 mm) nominal dimension.
 - 6. Reinforced Mullions: As required or recommended by manufacturer using manufacturer's standard profile of extruded aluminum with internal reinforcement of steel shaped structural section.
 - 7. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - 8. Basis of Design Product:

9. Kawneer North America; 601 Non-Thermal Framing System: www.kawneer.com.
- D. Aluminum Framing Members SF-4: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Construction: Nonthermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Rabbet: 3/8 inch (10 mm).
 4. Glazing Stops: Flush.
 5. Cross-Section: 1-3/4 inches wide by 4 inches deep (44.5 mm wide by 101.6 mm deep) nominal dimension.
 6. Reinforced Mullions: As required or recommended by manufacturer using manufacturer's standard profile of extruded aluminum with internal reinforcement of steel shaped structural section.
 7. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 8. Basis of Design Product:
 9. Kawneer North America; Trifab 400 Framing System (Non-Thermal): www.kawneer.com.
- E. Glazing: As specified in Section 08 8000 - Glazing.
- F. Swing Doors: Glazed aluminum, thermally broken.
1. Wide style.
 - a. Thickness: 1-3/4 inches (43 mm).
 - b. Top Rail: 5 inches (127 mm) wide.
 - c. Vertical Stiles: 5 inches (127.00 mm) wide.
 - d. Bottom Rail: 10 inches (254 mm) wide.
 - e. Glazing Rabbet: 1/4 inch monolithic
 - f. Glazing Stops: Square.
 - g. Finish: Same as storefront..
 - h. Design exterior doors for one inch insulating glass units.
 - i. Basis of Design Product:
 - 1) Kawneer North America; 500.
 - 2) Approved equal.
- G. Operable Sash: Aluminum project-out awning; finished to match storefront; turn handle latch with manufacturer's standard insect screen.
1. Class: AW-PG.
 2. Grade: 90AP
 3. Frame Depth: 2-1/4 inch (57.15 mm).
 4. Hardware:
 - a. Locking:
 - 1) Cast white bronze cam locks.
 - b. Hinging:
 - 1) 4-Bar hinges.
 - c. Limit Stops: Type approved by Authorities Having Jurisdiction and Owner. Limit opening to 4 inches maximum.
 5. Maximum opening and closing force not to exceed 5 lbs.
 6. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to window with adjustable hardware allowing screen removal without use of tools.
 - a. Hardware: Spring loaded steel pins; four per screen unit.
 - b. Screen Mesh: Aluminum, window manufacturer's standard mesh.
 - c. Frame Finish: Same as frame and sash.
 7. Basis of Design Product:
 - a. Kawneer North America; NX 3500.
 - b. Approved equal.

2.03 MATERIALS

- A. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District SCAQMD 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. A copy of SCAQMD 1168 is referenced in Section 01 8114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- B. Extruded Aluminum: ASTM B221 (ASTM B221M).
- C. Sheet Aluminum: ASTM B209 (ASTM B209M).
- D. Structural Steel Sections: ASTM A36/A36M; shop primed.
- E. Fasteners: Stainless steel.
- F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- G. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch (0.48 mm) minimum thickness.
- H. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- I. Perimeter Sealant: Type specified in Section 07 9200 - Joint Sealants.
- J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- K. Glazing Accessories: As specified in Section - 08 8000 - Glazing.
- L. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linRefer tod oil primer appropriate for use over hand cleaned steel.

2.04 SUN CONTROL DEVICES

- A. Aluminum Sun Shades: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 - 1. Configuration: As indicated on Drawings.
 - 2. Blade Type: Planar.
 - 3. Outrigger Shape: Straight.
 - 4. Fascia: Bullnose.
 - 5. Size: As indicated on Drawings.
 - 6. Extension Length: 30 inches (762 mm).
 - 7. Aluminum Finish: Match storefront system.
 - 8. Provide a complete system ready for erection at project site.
 - 9. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
 - 10. Basis of Design Product:
 - a. Kawneer North America; Versoleil SunShade - Outrigger System.
 - b. Approved equal.

2.05 ACCESSORIES

- A. Reinforcement: Where fasteners screw-anchor into aluminum less than 1/8 inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive, pressed-in splined grommet nuts.
- B. Brackets: High-strength aluminum brackets and reinforcements where possible; otherwise provide non-magnetic stainless steel or galvanized steel complying with ASTM A123/A123M.

- C. Inserts: Cast iron, malleable iron, or 12 gage galvanized steel for required anchorage to concrete or masonry.
- D. Sill Pans: Manufacturer's standard extruded profile, designed to direct moisture to the exterior at sill conditions; including splice sleeves and continuously sealed end dams.
- E. Comp-Heads: Manufacturer's standard extruded profile, designed to accommodate minimum one inch deflection of building elements at head conditions.
- F. Water Deflectors: Manufacturer's standard internal system accessory specifically designed to route internal water drainage away from top surfaces of insulated glass units.
- G. Expansion Anchors: Lead shield or toothed steel, drilled in type expansion bolts for required attachment to concrete or masonry.
- H. Bituminous Coatings: Cold-applied asphalt mastic, compounded for 30 mil thickness per coat.
- I. Internal System Sealants and Gaskets: As recommended by manufacturer for use within the framing system for fabrication, assembly, and installation. Use products which will remain permanently elastic, non-shrinking, and waterproof.

2.06 FINISHES

- A. Class I Clear Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
 - 1. Location: As indicated on Drawings.
- B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.
 - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 1.2 mil (0.030 mm).
 - 2. 3 coat metallic system.
 - 3. Color and Gloss: As selected by Architect from manufacturer's full range.
 - 4. Location: As indicated on Drawings.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 HARDWARE

- A. Door Hardware: As specified in Section 08 7100 - Door Hardware.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify dimensions, tolerances, and method of attachment with other work.
- C. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.03 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install wall system in accordance with manufacturer's instructions.
- D. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- E. Provide alignment attachments and shims to permanently fasten system to building structure.
- F. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- G. Provide thermal isolation where components penetrate or disrupt building insulation.
- H. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- I. Install sill pans with end dams; do not obstruct weep paths with sealants. Locate sill pan joints, if required, minimum 12 inches (305 mm) from centerline of vertical mullions. Seal to adjacent work to form water tight dam.
- J. Install comp-head units where detailed; do not secure comp-heads to primary storefront head frames.
- K. Install operating sash.
- L. Set thresholds in bed of sealant and secure.
- M. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Indicate entrance door hardware mounting heights on Drawings or insert in "Field-Installed Entrance Door Hardware" Subparagraph below.
 - 3. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- N. Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- O. Install internal system sealants as installation progresses. Seal sill pan splices, end dams, water deflectors, and other components to ensure that proper water weepage paths are established and maintained within the system.
- P. Install perimeter sealant in accordance with Section 07 9200 - Joint Sealants.

1. Install sealants according to storefront manufacturer's instructions; do not obstruct weep paths.

- Q. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.04 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- C. Location: Limit variation from plane or dimensioned location to 1/8 inch in 12 feet, non-cumulative, and 1/2 inch in overall length of member.

3.05 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. Refer to Section 01 4000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- D. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 1. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
- E. Test two samples; size samples according to ASTM E122.
- F. Refer to Section 01 4000 - Quality Requirements for retesting and reinspecting requirements and Section 01 7000 - Execution and Closeout Requirements Requirements for requirements for correcting the Work.
- G. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.07 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess sealant by method acceptable to sealant manufacturer.

3.08 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.
- B. Aluminum doors and frames.
- C. Anchorage and fastening systems.
- D. Associated sheet metal flashings and trim.
- E. Field and preconstruction testing of installed systems.
- F. Design engineering of framing system and load-bearing anchorage systems and connections to building structural frame.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with installation of other components that comprise the exterior enclosure.
 - 2. Coordinate compatibility and design integrity to secure a weather and water tight seal with all systems, adjacent surfaces and related materials.
 - 3. Coordinate attachment and seal of perimeter air and vapor barrier materials.
 - 4. Coordinate and assume responsibility for compatibility and proper performance of sealants used as part of the work of this Section with sealants used by other trades that may be in direct contact with or adjacent to sealants used as part of the work of this Section.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this Section.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Discuss construction document requirements, required clarifications to construction documents, construction schedule, coordination of affected trades, construction contraction and isolation joints, joint-filler strips, submittal requirements, approved submittals, and required inspections.
 - 3. Required Attendance: Contractor's quality control supervisor or superintendent, Architect, Owner's independent testing agency, and all affected trades including reinforcing subcontractor and concrete supplier.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Pre-submittal Package:
 - a. Submit profile drawings for all typical areas of building including relationship to adjacent construction, indicating same quality and content of scope required for building drawings, except that non-typical conditions need not be included.
 - b. Provide itemized list of specification requirements and architectural drawing requirements which are not explicitly included in contract documents, but which are required to achieve specified performance.
 - 1) Identify specification Section and paragraph, and Drawing sheet, elevation, plan, section or detail for each item.
 - 2) Deviations not specifically identified in pre-submittal package may be cause for disapproval during submittal review.
 - 3) If no deviations are identified, provide written statement of full compliance with contract documents.

- 4) Failure to provide itemized list of deviations, if any, or statement of full compliance may be cause for return of submittals without review; any resulting delay is responsibility of Contractor.
- c. Dewpoint Analysis: Project specific indoor dewpoint analysis report for each individual system utilizing NFRC-Approved THERM(r) computer simulation software.
 - 1) Utilize project specific design shapes for each system, ambient indoor and outdoor temperatures, and relative humidity; performed by qualified design professional to determine indoor dewpoint temperature and indoor metal surface temperatures.
 - 2) Indoor and Outdoor Temperatures and Relative Humidity: Use same numerical values used in HVAC system design.
2. Prior To Commencement of Construction:
 - a. Provide glass manufacturers wind and thermal stress analysis, and center deflection calculations indicating that specified maximum probabilities of breakage are not exceeded.
 - b. Provide glass manufacturer's written statement that insulated, heat treated, reflective, spandrel and laminated glass is suitable for indicated applications. Submit letter stating manufacturer has reviewed curtain wall submittals and has approved glazing specifications and details included in curtain wall submittals.
 - c. Provide sealant manufacturers test reports confirming adhesion of sealant to all relevant substrates.
 - 1) Provide samples of sealant materials to sealant manufacturer for adhesion tests.
 - 2) Evaluate adhesion, confirm acceptability after initial cure and after water immersion for seven days.
 - 3) Evaluate adhesion of immersed samples immediately after removal from water.
 - 4) Provide stain test reports on stone and precast panels.
 - 5) Provide written certification from sealant manufacturer that specified sealants are compatible with all adjacent materials and finishes.
 - 6) Provide submittal review by sealant manufacturer.
3. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
4. Shop Drawings: Indicate materials in place on building including coordination of related and adjoining work, insert drawings, and erection diagrams. Show relative layout for all adjacent walls, beams, columns slabs, ceilings, and similar items. Include elevations, floor plans, sections and full size details. Provide isometric details of jamb sill, jamb head, and intermediate mullion joinery, and any conditions, as requested by the Architect. Include the following information:
 - a. Full size details, fully drawn, not outlined. Provide isometric details of any conditions, if requested by Architect.
 - 1) Joinery and internal weather seals.
 - 2) Glass and metal thicknesses, including tolerances.
 - 3) Metal alloy, temper, and finish.
 - 4) Glass manufacturer strength, thickness, tint, coating, opacifier or ceramic frit, safety backing, and rating of insulated units.
 - 5) Fastener manufacturer, material alloy, plating, diameter, length, spacing, embedment, and edge distances.
 - 6) Glazing materials identification.
 - 7) Sealant identification by product name and manufacturer, including cleaning and priming requirements.
 - 8) Relative layout of walls, beams, columns and slabs with dimensions noted. Dimension all tolerances required or which can be accommodated.
 - 9) Field connections, weld sizes, anchorages and fasteners, embedment length and edge distances.
 - 10) Dimensioned position of glass edge relative to metal daylight.
 - 11) Re-glazing and glazing procedures.
 - 12) Dimension limits of movements for all moving joints, and provisions for expansion and contraction.

- 13) Spotting plans for preset inserts in structure or in adjacent construction.
 - 14) Perimeter sealant joint sizes, including tolerances and minimum/maximum joint sizes required.
 - 15) Seal and signature of professional engineer currently registered in the State in which the Project is located; same engineer who seals and signs design calculations.
5. Samples: Submit three samples of all materials included in the work of this Section, in size required to adequately illustrate material properties and characteristics. Include:
- a. Extrusions, flat sheet, infill panels, or formed shapes showing finish. Provide range samples showing variations in color and texture, if any; minimum 12 x 12 inch size.
 - b. Fabrication samples showing prime members, joinery, anchorage, expansion provisions, glazing, sealant details, profiles, and intersections.
 - c. Technical data on proposed sealants, with color chart and cured samples; 6 inch long.
 - d. Gasket and sealant test reports, and technical data on all glazing accessories.
- B. Informational Submittals:
1. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
 2. Test Reports: Submit results of full-size mock-up (preconstruction) testing. Reports of tests previously performed on the same design are acceptable provided they meet the performance requirements of this specification.
 3. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
 - b. Structural Calculations: Provide structural calculations, sealed and signed by a professional engineer licensed in the State in which the Project is located. Test reports are not an acceptable substitute for calculations. Include the following information:
 - 1) Analysis for applicable loads on framing members.
 - 2) Analysis for applicable loads on anchors, including anchors embedded in concrete.
 - 3) Section property computations for framing members.
 - 4) Analysis of structural silicone at structural glazing applications, identifying minimum required sealant bite and width required to transfer design loads from glass to framing.
 4. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
 5. Designer's Qualification Statement.
 6. Manufacturer's Qualification Statement.
 7. Installer's Qualification Statement.
 8. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
 9. Maintenance Data: For glazed aluminum wall system including in maintenance manuals.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 5.504.4.1 Adhesives and sealants.
 2. 5.504.4.3 Paints and coatings.
 3. 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Laboratory Mockup Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and AAMA certified.
- C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- D. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions, and color.
- E. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum 10 years of documented experience.
 - 1. Engage single firm to assume sole responsibility for fabrication, installation, and coordination of all components of the work of this Section.
- F. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- G. Owner and Architect reserve right to visit fabricating and manufacturing facilities, sub-contractor or material supplier, and testing laboratory at any time during progress of work.
 - 1. Shop and field materials, and workmanship, are subject to observation and evaluation by Architect or his representative at all times.
 - 2. Such inspections do not relieve Contractor from obligation to provide curtain wall system conforming to all requirements of the Contract Documents.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000.
- B. Provide mock-up including all components occurring on project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, insulation, window washing tie-backs, finishes, and perimeter sealant.
 - 1. Scope of mock-up is as shown on mock-up scope drawings.
 - 2. Construct mock-ups in strict accordance with approved mock-up shop drawings. Deviation of details from mock-up shop drawings are subject to approval of Architect.
 - 3. Do not use excessive amounts of sealant, nor other special measures or techniques, which are not representative of those to be used on the building.
 - 4. Delay installation of thermal insulation until completion of initial air, water and structural tests.
 - 5. Locate on-site where directed. Mock-up may remain as part of the Work.
- C. Provide at least one extra light of glass for each type and size on mock-up. Replace glass which breaks during testing with new glass, and continue test.
 - 1. Repeated glass breakage at design pressures constitutes failure.
- D. Mock-up is subject to observation by Contractor, Architect and its consultants throughout construction and testing.
 - 1. Provide minimum three weeks notice before beginning construction of mock-up.
 - 2. Provide materials and personnel for prompt continuous construction of mock-up.
 - 3. Delays in mock-up construction could result in Contractor being charged for fees and travel expenses of observers.
- E. Prior To Mock-up Installation:

1. Provide to sealant manufacturer samples of all relevant substrates, including finished aluminum, coated glass, gaskets, panels, backers, and other substrates which will require sealant contact.
2. Identify and label samples for this project.
3. Perform tests by sealant manufacturer to verify adhesion, staining, and chemical compatibility.
4. Use sealants and substrates only in combinations for which favorable adhesion and compatibility results have been obtained.
5. Submit sealant manufacturer's written test reports and recommendations for cleaning and priming required to obtain acceptable adhesion.

1.07 PRECONSTRUCTION TESTING

- A. Full-Size Mock-up Testing: Have a specimen representative of project conditions tested by an independent testing agency for compliance with specified structural, air infiltration, water penetration, thermal, and sound attenuation criteria.
- B. Testing Facility: Conduct tests at an AAMA accredited independent testing laboratory, approved by Contractor and Architect. Testing laboratory responsible for conducting and reporting tests, statement in report whether or not test specimen conforms to requirements of contract documents, and notation of specific deviations, if any.
 1. Submit testing facility's proposed test procedure for Architect's approval minimum four weeks prior to erection. Do not commence erection at testing laboratory prior to review of testing facility's proposed test procedure.
- C. Testing Laboratory Limitations: Not permitted to act as consultant to Contractor or any subcontractor on this project, modify contract document requirements, modify mock-up configuration, or dismantle mock-ups until notified that no further testing is required. At direction of Architect, deliver mock-up or selected portions of mock-up, boxed, to Project Site or or dispose of mock-up properly.
- D. Test Failures: If failures occur, revise and re-test mock-up. Modifications must be realistic in terms of job conditions, must maintain specified standards of quality and durability, and are subject to approval of Architect.
- E. Performance Requirements: Requirements specified apply to test mock-ups and samples and actual building. Variations in criteria such as wind pressure over surface of building are to be taken into account in testing of mock-ups and samples. Where certain performance is required for specific test conditions of mock-ups and samples, that same performance is also required of the actual building, for natural conditions equivalent to or less severe than the test conditions.
- F. Laboratory Test Report: Accompanied by "as built" mock-up drawing showing revisions or corrective measures taken during testing, if any. Modifications to mock-up must be implemented on Project, unless specifically approved otherwise by Architect. Mock-up must be supervised and installed by same work crew that will supervise and install the work on the Project.
- G. Test mock-up test specimen in following order:
 1. Preload specimen at 50 percent of inward (positive) design pressure.
 2. Air leakage according to ASTM E283/E283M using a pressure of 6.24 psf (50 mph wind). Air leakage not to exceed 0.06 cfm per square foot of projected gross wall area. Individual components not to exceed 0.06 cfm per square foot of component. Verify air flow thru each component of the specimen.
 3. Static water penetration according to ASTM E331 using a pressure of 12 psf. Uncontrolled water penetration not permitted.
 4. Dynamic water penetration according to AAMA 501.1 using a pressure of 12 psf. Uncontrolled water penetration not permitted.
 5. Thermal performance test according to AAMA 501.5 for three complete thermal cycles.
 6. Repeat air leakage test.
 7. Repeat static water test.

8. Structural performance according to ASTM E330/E330M using 30 psf positive and 35 psf negative design load pressures. Measure and record deflections.
 9. Test window washer tie-back to 150 lb. design loads. Apply loads in lateral direction, parallel to wall, left and right, pull out perpendicular to wall, and pull up and down parallel to wall. Signs of deformation or yielding not permitted.
 10. Repeat static water penetration test according to ASTM E331 using a pressure of 12 psf. Uncontrolled water penetration not permitted.
 11. Structural overload test according to ASTM E330/E330M using 1.5 times the design load pressure. Measure and record deflections. Permanent set of more than L/1000 not permitted. Permanent set in anchors of more than 1/16 inch not permitted.
 12. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
 - a. Air Infiltration: ASTM E283/E283M.
 - b. Water Penetration under Static Pressure: ASTM E331.
 13. Vertical Interstory Movement: AAMA 501.7. Repeat the following:
 - a. Air Infiltration: ASTM E283/E283M.
 - b. Water Penetration under Static Pressure: ASTM E331.
 14. Test window washer tie-back to 4 times design load. Apply loads in directions as indicated for window washer tie-back test. Yielding and loosening may occur, but catastrophic failures are not permitted.
- H. Where test sequence or test failures require successive water infiltration tests, the only means permitted to drain water from internal cavities is gravity drainage through weep system for minimum 15 minutes. Air pressure, removal of parts, or other means of draining water is not permitted.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this Section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.
- B. Take required precautions to properly isolate and prevent any degree of incompatibility between sealants, in strict accordance with sealant manufacturer's specifications, recommendations, and instructions.
- C. Periodically test sealants in place for adhesion using methods recommended by sealant manufacturer. Promptly replace sealants which do not adhere or fail to cure.

1.10 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
 1. Defective work is defined to include, but not be limited to, evidence of:
 - a. Penetration of water into building.
 - b. Air infiltration exceeding specified limits.
 - c. Structural failure of components resulting from forces within specified limits.
 - d. Delamination of laminated glass or failure of insulated glass units.
 - e. Secondary glass damage or damage due to falling components.
 - f. Adhesive or cohesive failure of sealants.
 - g. Cracking on surface of non-structural sealants.
 - h. Non-structural sealant hardening beyond Shore A durometer 50 or softening below 20.
 - i. Failure to comply with specified performance requirements.
 - j. Failure of operating parts to function normally and properly.

- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, flaking, pitting, peeling, crazing, or non-uniformity of finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. Kawneer North America: www.kawneer.com.
 - 2. Other Acceptable Manufacturers:
 - a. Arcadia, Inc: www.arcadiainc.com.
 - b. C.R. Laurence Company, Inc; U.S. Aluminum: www.crl-arch.com.
 - c. Kawneer North America: www.kawneer.com.
 - d. Oldcastle Building Envelope: www.oldcastlebe.com.
 - e. Approved equal.

2.02 CURTAIN WALL SYSTEM - GENERAL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Outside glazed, with pressure plate and mullion cover.
 - 2. Fabrication Method: Field fabricated stick system.
 - 3. Glazing Method: Field glazed system.
 - 4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - a. Fabricate individual system frame members, comp heads, and other system components in single, continuous pieces; splices are not permitted unless specifically required by project installation conditions, or for designed expansion control of system.
 - 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 6. System Internal Drainage: Drain any water entering joints to the exterior by means of a weep drainage network; this includes condensation occurring in glazing channel and migrating moisture occurring within system.
 - a. Install pressure plates with weep holes located above glazing support flanges to properly allow water to weep to exterior through cover plates. Provide minimum of 2 weep holes in each exterior face cap section.
 - 7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.
 - 8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:

- a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
3. Failure of operating units
- C. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
- 1. Design Wind Loads: Comply with the following:
 - a. Wind Loads: As indicated on Drawings.
 - b. Other Design Loads: As indicated on Drawings
 - c. Maximum Water Leakage: According to AAMA 501.1. No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
 - d. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
 - e. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
 - f. Member Deflection: For spans over 13 feet 6 inches (4115 mm) and less than 40 feet (12.2 m), limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch (1/240 of span plus 6.4 mm), with full recovery of glazing materials.
 - 2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
 - 3. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
 - 4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- D. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
- 1. Test Pressure Differential: 12 psf (575 Pa).
 - 2. Maximum Water Leakage: According to AAMA 501.1. No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- E. Air Leakage: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.
- F. Thermal Performance Requirements:
- 1. Condensation Resistance Factor of Framing: 70, minimum, measured in accordance with AAMA 1503.
- G. Door Opening Force
- 1. Interior hinged doors: 5 pounds maximum.
 - 2. Required fire doors: 15 pounds maximum.

3. Exterior hinged doors: 5 pounds maximum

2.04 CURTAIN WALL - STICK SYSTEM

- A. Aluminum Curtain Wall: Thermally broken, factory fabricated, factory finished aluminum framing members with infill, related flashings, anchorage, and attachment devices.
 1. Outside glazed, with pressure plate and mullion cover where indicated.
 2. Two-side structural sealant glazed with horizontal pressure plates and exterior covers, where indicated Four-side structural sealant glazed.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
 1. Vertical Framing Member Cross-Section: 2-1/2 by 10-1/2 inches (63.5 by 267 mm).
 2. Horizontal Framing Member Cross-Section: 2-1/2 by 7-1/2 inches (63.5 by 190.5 mm) nominal dimension.
 3. Reinforced Mullions: As recommended by manufacturer using manufacturer's standard profile of extruded aluminum with internal reinforcement of steel shaped structural section.
 4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 5. Glazing System: Retained mechanically with gaskets on four sides.
 6. Glazing Rabbet: 1 inch insulated
 7. Glazing Plane: Front.
 8. Integrated brackets for support of vertical fins (where occurs).
 9. Basis of Design Product:
 - a. Kawneer North America; 1600 UT Systems 1: www.kawneer.com.
- B. Swing Doors: As specified in Section 08 4313 - Aluminum-Framed Storefronts.
- C. Glazing: As specified in Section 08 8000 - Glazing.
- D. Operable Sash: As specified in Section 08 4313 - Aluminum-Framed Storefronts.

2.06 MATERIALS

- A. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- B. Extruded Aluminum: ASTM B221 (ASTM B221M).
- C. Sheet Aluminum: ASTM B209 (ASTM B209M), color to match framing.
- D. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- E. Structural Supporting Anchors: As specified in Section 05 1200 - Structural Steel Framing.
- F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- G. Concealed Flashings: Stainless steel, 24 gage, 0.025 inch (0.64 mm) minimum thickness.
- H. Anchorage and Fasteners: Concealed unless specifically approved to be exposed by Architect; carbon steel galvanized according to ASTM B633. Exposed fasteners if approved, and fasteners in wet areas of the wall; series 300 stainless steel.
 1. Finish of Exposed Items: Match adjacent mullion color.
 2. Self Drilling Fasteners: Dril-Flex as manufactured by Elco Industries, Inc.; substitutions not permitted.
 3. Nuts Used at Expansion or Moving Connections: Designed to provide positive means of preventing disengagement.
 - a. Not Permitted: Stacking of bolts, use of lock washers, or thread deformation.

- b. Use matched bolts, nuts, and washers at friction connections.
- I. Exposed Flashings: Minimum 0.040 inch (1.0 mm) thick aluminum sheet; finish to match framing members.
- J. Concealed Flashings: 0.018 inch (0.5 mm) thick stainless steel.
- K. Firestopping: As specified in Section 07 8400 - Firestopping.
- L. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
- M. Sill Flashing Sealant: Silicone compatible with flashing material.
- N. Perimeter Sealant: As specified in Section 07 9200 - Joint Sealants.
- O. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- P. Glazing Accessories: As specified in Section 08 8000 - Glazing.
- Q. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- R. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.07 SUN CONTROL DEVICES

- A. Refer to Section 08 4313 - Aluminum-Framed Storefronts.

2.08 ACCESSORIES

- A. Reinforcement: Where fasteners screw-anchor into aluminum less than 1/8 inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive, pressed-in splined grommet nuts.
- B. Brackets: High-strength aluminum brackets and reinforcements where possible; otherwise provide non-magnetic stainless steel or galvanized steel complying with ASTM A123/A123M.
- C. Inserts: Cast iron, malleable iron, or 12 gage galvanized steel for required anchorage to concrete or masonry.
- D. End Dam Blocks: Manufacturer's standard internal system accessory specifically designed to seal internal gaps and route internal water drainage to weeps.
- E. Expansion Anchors: Lead shield or toothed steel, drilled in type expansion bolts for required attachment to concrete or masonry.
- F. Bituminous Coatings: Cold-applied asphalt mastic, compounded for 30 mil thickness per coat.
- G. Shims: 100 percent nylon; high density.
- H. Internal System Sealants and Gaskets: As recommended by manufacturer for use within the framing system for fabrication, assembly, and installation. Use products which will remain permanently elastic, non-shrinking, and waterproof.

2.09 FABRICATION

- A. To fullest extent practicable, fabricate and assemble each system at factory. Where factory assembly is not practicable, fabricate, shop fit, and mark system components to ensure proper assembly in field.
- B. Fabricate components with clearances and shim spacing around perimeter of assembly that will accommodate system and building movements, and construction tolerances, and enabling

installation and dynamic movement of perimeter sealers. Design for sealant joint width as specified in Section 07 9200 - Joint Sealants.

- C. Fabricate individual system frame members, comp heads, and other system components in single, continuous pieces; splices are not permitted unless specifically required by project installation conditions, or for designed expansion control of system.
- D. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- E. Fabricate all miter and 90 degree joints at the factory.
- F. Develop drainage paths with moisture weep to exterior. Install pressure plates with weep holes located above glazing support flanges to properly allow water to weep to exterior through cover plates. Provide minimum of 2 weep holes, no more than 24 inches (610 mm) on center, in each exterior face cap section.
- G. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum wall system and secondary seal weeped and vented to exterior. Prepare components to receive anchor devices. Fabricate anchors.
- H. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- I. Arrange all fasteners and attachments to be concealed from view.
- J. Fasteners shall not penetrate gutters or drainage systems.
- K. Arrange all welds to be concealed from view. Welds may not telegraph to finished surfaces.
- L. Completely seal all welds in areas intended to retain water with an approved sealant.
- M. Reinforce framing members for imposed loads.
- N. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies, including exposed fasteners.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

2.10 FINISHES

- A. Class I Clear Anodized Finish: AAMA 611 AA-M12 2241 clear anodic coating or AAMA 612 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils (0.018 mm) thick.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify dimensions, tolerances, and method of attachment with other related work.
- C. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.
- D. Verify that anchorage devices have been properly installed and located.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.03 INSTALLATION

- A. General:
 1. Install curtain wall systems in accordance with manufacturer's instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 7. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- D. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- E. Provide alignment attachments and shims to permanently fasten system to building structure.
- F. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- G. Provide thermal isolation where components penetrate or disrupt building insulation.
- H. Install sill, head, and sill pan flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- I. Install comp-head units where detailed; do not secure comp-heads to primary head frames.
- J. Coordinate installation of firestopping at each floor slab edge.
- K. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- L. Install flashings and other specified accessory components.
- M. Pressure Plate Framing: Install glazing in accordance with Section 08 8000, using exterior dry glazing method.
 1. Secure vertical face caps to pressure plates to prevent migration of face caps due to gravity or temperature cycling; use matching finish flush head screws, of size and length that will not contact glass unit.
- N. Install internal system sealants as installation progresses. Seal end dam blocks and other components to ensure that proper water weepage paths are established and maintained within the system.

- O. Install perimeter sealant in accordance with Section 07 9200 - Joint Sealants.
 - 1. Install sealants according to curtainwall manufacturer's instructions; do not obstruct weep paths.
 - 2. Design joint width in accordance with ASTM C1472 and sealant manufacturer's recommendations.
- P. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.04 TOLERANCES

- A. Plumb: 1/8 inch (3.17 mm) in 10 feet (3 m); 1/4 inch (6.35 mm) in 40 feet (12.2 m).
- B. Level: 1/8 inch (3.17 mm) in 20 feet (6 m); 1/4 inch (6.35 mm) in 40 feet (12.2 m).
- C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- D. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 3/16 inch.
- E. Alignment: Where surfaces abut in plane, limit offset to 1/16 inch (1.58 mm); where reveal or protruding element separates aligned surfaces by less than 2 inches, limit offset to 1/4 inch (6.35 mm).
- F. Location: Limit variation from plane or dimensioned location to 1/8 inch (3.17 mm) in 12 feet, non-cumulative, and 1/2 inch (12.70 mm) in overall length of member.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.
- C. Refer to Section 01 4000 - Quality Requirements, for general testing and inspection requirements.
- D. Test installed curtain wall for water leakage in accordance with AAMA 501.2 with a uniform test pressure difference of 12 psf with no reduction for in-field testing.
 - 1. Perform a minimum of three tests in areas as directed by Architect.
- E. Provide field testing of installed curtain wall system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf (200 Pa).
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce (14 gram) that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
 - 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf (75 Pa).
- F. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq ft (75 Pa).
 - 1. Perform a minimum of two tests in areas as directed by Architect.
- G. Test two samples; size samples according to ASTM E122.
- H. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.06 ADJUSTING

- A. Adjust operating sash for smooth operation.

3.07 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess sealant by method acceptable to sealant manufacturer.

3.08 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

**SECTION 08 4500
TRANSLUCENT WALL AND ROOF ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Self supporting aluminum framed sloped glazing system.
- B. Sandwich panels of translucent skins separated with an aluminum grid.
- C. Design engineering of framing system and load-bearing connections to building structural frame system.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with installation of firestopping, air barrier, and vapor retarder.
 - 2. Coordinate installation of air stop at edge of construction.
 - 3. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- B. Preinstallation Meeting: Convene one week before starting work of this Section.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, panel configuration, internal drainage details and finishes for aluminum components of panel assemblies.
 - 2. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related work, weep drainage network, expansion and contraction joint location and details, and field welding required.
 - a. Include plans, elevations, sections, details, and attachments to other work.
 - b. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
 - 3. Samples: In manufacturer's standard size.
 - a. For each type of fiberglass-sandwich panel.
 - b. For each type of exposed finish for framing members.
 - 4. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch (305-mm) lengths of full-size framing members and showing details of the following:
 - a. Joinery.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Fiberglass-sandwich panels.
 - e. Flashing and drainage.
- B. Informational Submittals:
 - 1. Delegated-Design Submittal: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Design Data: Show structural and physical characteristics, engineering calculations, and dimensional limitations.
 - 2. Test Reports: Substantiating engineering data, test results of previous tests by independent laboratory demonstrating compliance with performance requirements.
 - 3. Installation Data: Special installation requirements.
 - 4. Designer's Qualification Statement.
- C. Closeout Submittals:
 - 1. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AAMA CW-DG-1.
- B. Designer Qualifications: Design structural support framing components under direct supervision of Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than three years of documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings.

1.07 MOCK-UPS

- A. Comply with general mock-up requirements specified in Section 01 4339.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical panel assemblies as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle work of this Section in accordance with AAMA CW-10.
- B. Protect prefinished aluminum surfaces with wrapping; do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
 - 1. Puncture wrappings at ends for ventilation.

1.09 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).
- B. Maintain this minimum temperature during and after installation of sealants.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Water leakage.
 2. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace translucent panels that exhibit defects in materials or workmanship within specified warranty
1. Defects include, but are not limited to, the following:
 - a. Delamination.
 - b. Color changes exceeding requirements.
 - c. Losses in light transmission beyond 6 percent from original when measured according to ASTM D 1003.
 2. Warranty Period: 10 years from date of Substantial Completion.
- D. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer Sandwich Panel - Translucent Canopy Assemblies:
1. Kalwall: www.kalwall.com.
 2. Other Acceptable Manufacturers:
 - a. Enduro Composites, Inc: www.endurocomposites.com.
 - b. Major Industries, Inc.: www.majorskylights.com.
 - c. SABIC Innovative Plastics US LLC: www.sabic.com.
 - d. Approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design translucent structural panel assemblies.
- B. Structural Loads: As indicated on Drawings.
- C. Deflection Limits:
1. Vertical Panel Assemblies: Limited to 1/120 of clear span for each assembly component.
 2. Overhead Panel Assemblies: Limited to 1/60 of clear span for each assembly component.
- D. Structural-Test Performance: Panel assemblies tested according to ASTM E 330, as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified deflection limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a

minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

- F. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
 - 1. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water that is controlled by flashing and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.
- G. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (50 deg C), ambient; 180 deg F (82 deg F), material surfaces.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F (4.54 W/sq. m x K) as determined according to NFRC 100.
 - 2. Solar-Heat-Gain Coefficient (SHGC): Fixed glazing and framing areas shall have an SHGC of no greater than 0.7 as determined according to NFRC 200.
 - 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
 - 4. Air Infiltration: Maximum air leakage through fixed glazing and skylight framing assemblies of 0.20 cfm/sq. ft. (1.02 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - 5. Air Infiltration: Maximum air leakage through fixed window glazing and framing assemblies of 0.20 cfm/sq. ft. (1.02 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - 6. Air Infiltration: Maximum air leakage through fixed curtain wall glazing and framing assemblies of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

2.03 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

- A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.
 - 1. Basis of Design Manufacturer:
 - a. Kalwall Corporation; 2 3/4" Kalwall Supported Roof : www.kalwall.com.
 - b. Other Acceptable Manufacturers:
 - 1) Major Industries, Inc..
 - 2) Prior approved equal.

2.04 COMPONENTS

- A. Translucent Roof System: Structurally reinforced translucent panels, with self supporting framing, shop fabricated, factory prefinished, battens, cap strips, related flashings, anchorage and attachment devices.
- B. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.
 - 1. Core Insulation: NONE
 - 2. Panel Thickness: 2 3/4"

- C. Grid Core: Mechanically interlocked, extruded-aluminum or thermally broken I-beams, with a minimum flange width 7/16 inch (11 mm).
 - 1. Extruded Aluminum: ASTM B221 (ASTM B221M), in alloy and temper recommended in writing by manufacturer.
 - 2. I-Beam Construction: TYPE 2 - One piece, extruded aluminum or TYPE 1 - Thermally broken TBH, see drawings.
- D. Exterior Face Sheet:
 - 1. Thickness: 0.070 inch (1.78 mm).
 - 2. Color: Crystal.
 - 3. Protective Weathering Surface: Manufacturer's standard.
- E. Interior Face Sheet:
 - 1. Thickness: 0.045 inch (1.14 mm).
 - 2. Color: White.
- F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.
- G. Face Sheets: Fiberglass reinforced polymer (FRP).
 - 1. Type: Flat panel.
 - 2. Exterior Face Sheet: Translucent, and smooth.
 - 3. Interior Face Sheet: Translucent, and smooth.

2.05 FRAMING MATERIALS

- A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: One piece, extruded aluminum.
- B. Aluminum Materials - General: Comply with recycled content product requirements specified in Section 01 8114.
- C. Extruded Aluminum: ASTM B221 (ASTM B 221M).
- D. Sheet Aluminum: ASTM B209 (ASTM B 209M).
- E. Structural Profiles: ASTM B308/B308M.
- F. Closure system:
 - 1. Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.
- G. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- H. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
 - 1. At closures, retaining caps, or battens, use ASTM A193 (/A 193M), 300 series stainless-steel screws.
 - 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

- I. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- J. Framing Gaskets: Manufacturer's standard.
- K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 ACCESSORIES

- A. Reinforcement: Where fasteners screw-anchor into aluminum less than 1/8 inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive, pressed-in splined grommet nuts.
- B. Brackets: High-strength aluminum brackets and reinforcements where possible; otherwise provide non-magnetic stainless steel or galvanized steel complying with ASTM A123/A123M.
- C. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of Bay Area Air Quality Management District (BAAQMD), CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. A copy of (BAAQMD) is referenced in Section 018114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- D. Sealants and Gaskets: As recommended by manufacturer for use within the framing system for fabrication, assembly, and installation. Use products which will remain permanently elastic, non-shrinking, and weatherproof. Perimeter and glazing sealants are specified in other Sections.

2.07 FABRICATION

- A. Frame System Fabrication:
 - 1. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.
 - 2. Fabricate sill closures with weep holes and for installation as continuous component.
 - 3. Reinforce components as required to receive fastener threads.
- B. Panel Fabrication: Factory assemble and seal panels.
 - 1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
 - 2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
 - 3. Fabricate panel to allow condensation within panel to escape.
 - 4. Reinforce panel corners.
- C. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, and ensure proper installation and dynamic movement of perimeter seals.
- D. Accurately fit and secure joints and corners. Make joints flush and hairline.

2.08 FINISHES

- A. Manufacturer's factory applied finish which meets the performance requirements of AAMA 2604. Color to match Kalwall KCRF Alum No. 79.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify dimensions, tolerances, and method of attachment with other work.
- C. Verify wall openings and adjoining air barrier and vapor retarder materials are ready to receive work of this Section.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
 - 1. Do not install damaged components.
 - 2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
 - 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install components plumb and true in alignment with established lines and elevations.
- D. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- E. Provide alignment attachments and shims to permanently fasten system to building structure.
- F. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.
- G. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm/m) non-cumulative or 1/2 inch per 100 feet (12.7 mm/30 m), whichever is less.
- B. Sealant Space Between Panel System Members and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6.4 mm).
- C. Alignment: Where surfaces abut in plane, limit offset to 1/16 inch; where reveal or protruding element separates aligned surfaces by less than 2 inches, limit offset to 1/4 inch.
- D. Location: Limit variation from plane or dimensioned location to 1/8 inch in 12 feet, non-cumulative, and 1/2 inch in overall length of member.

3.04 FIELD QUALITY CONTROL

- A. Provide the services of the manufacturer's field representative to observe installation and make report.
- B. Provide independent inspection under provisions of Section 01 4000 - Quality Requirements.
- C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.
 - 2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E1105.
 - a. Test Procedures: Test under uniform static-air pressure.
 - b. Static-Air-Pressure Difference.
 - c. Water Penetration: None.

3.05 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down interior and exterior surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths; remove dirt from corners and wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.06 PROTECTION

- A. Protect finished work from damage until Date of Substantial Completion.

END OF SECTION

**SECTION 08 7100
DOOR HARDWARE**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
 - 1. Door Hardware, including electric hardware.
 - 2. Storefront and Entrance door hardware.
 - 3. Low-energy door operators plus sensors and actuators.
 - 4. Thresholds, gasketing and weather-stripping.
 - 5. Door silencers or mutes.

1.03 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

- A. 2019 California Building Code, CCR, Title 24.
- B. BHMA – Builders' Hardware Manufacturers Association
- C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- D. DHI – Door and Hardware Institute
- E. NFPA - National Fire Protection Association.
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- F. UL - Underwriters Laboratories.
 - 1. UL 10C - Fire Tests of Door Assemblies
 - 2. UL 305 - Panic Hardware
- G. WHI - Warnock Hersey Incorporated
- H. SDI - Steel Door Institute

1.04 SUBMITTALS & SUBSTITUTIONS

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit six (6) copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
 - 1. Include a Cover Sheet with;
 - a. Job Name, location, telephone number.
 - b. Architects name, location and telephone number.
 - c. Contractors name, location, telephone number and job number.

- d. Suppliers name, location, telephone number and job number.
- e. Hardware consultant's name, location and telephone number.
- 2. Job Index information included;
 - a. Numerical door number index including; door number, hardware heading number and page number.
 - b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
 - c. Manufacturers' names and abbreviations for all materials.
 - d. Explanation of abbreviations, symbols, and codes used in the schedule.
 - e. Mounting locations for hardware.
 - f. Clarification statements or questions.
 - g. Catalog cuts and manufacturer's technical data and instructions.
- 3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number – HW -1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		
(g) 1	(h)	(i) ea	(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea	Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keyset Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.05 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Responsible for detailing, scheduling and ordering of finish hardware.
 - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing. To maintain the integrity of patented key systems provide a letter of authorization from the specified manufacturer indicating that supplier has authorization to purchase the key system directly from the manufacturer.
 - 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.07 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
 - 1. Locksets: "ND" Ten (10) years.
 - 2. Electronic: One (1) year.
 - 3. Closers: Thirty (30) years--except electronic closers shall be two (2) years.
 - 4. Exit devices: Three (3) years.
 - 5. All other hardware: Two (2) years.

1.08 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.09 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
Hinges	Ives	None-Owner Standard
Locks, Latches & Cylinders	Schlage	None-Owner Standard
Exit Devices	Von Duprin	None-Owner Standard
Closers	LCN	None-Owner Standard
Auto Operators	LCN	None-Owner Standard
Push, Pulls & Protection Plates	Ives	None-Owner Standard
Flush Bolts	Ives	None-Owner Standard
Dust Proof Strikes	Ives	None-Owner Standard
Coordinators	Ives	None-Owner Standard
Stops	Ives	None-Owner Standard
Overhead Stops	Glynn-Johnson	None-Owner Standard
Thresholds	Zero	None-Owner Standard
Seals & Bottoms	Zero	None-Owner Standard

MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
 - 1. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 42" wide: 4-1/2" inches.
 - 2) Doors 43" to 48" wide: 5 inches.
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.

- c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 - 2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
- B. Continuous Hinges: As manufactured by Ives, an Allegion Company. UL rated as required.
- C. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.
 - 1. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
 - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
 - b. Offset lever pull – minimum 1,600 foot pounds without gaining access
 - c. Vertical lever impact – minimum 100 impacts without gaining access
 - 2. Cycle life - tested to minimum 16 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers
 - 3. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
 - 4. Cylinders: Refer to "KEYING" article, herein.
 - 5. Provide solid steel anti-rotation through bolts and posts to control excessive rotation of lever.
 - 6. Provide lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
 - 7. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw capable of UL listing of 3 hours on a 4' x 10' opening. Provide proper latch throw for UL listing at pairs.
 - 8. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 - 9. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 - 10. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - 11. Provide wired electrified options as scheduled in the hardware sets.
 - a. 12 through 24 volt DC operating capability, auto-detecting
 - b. Selectable EL (fail safe)/EU (fail secure) operating mode via switch on chassis
 - c. 0.230A (230mA) maximum current draw
 - d. 0.010A (10mA) holding current
 - e. Modular / "plug in" request to exit switch
 - 12. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
- D. Exit devices: Von Duprin as scheduled.
 - 1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
 - 2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
 - 3. Mechanism case shall have an average thickness of .140".
 - 4. Compression spring engineering.
 - 5. Non-handed basic device design with center case interchangeable with all functions.
 - 6. All devices shall have quiet return fluid dampeners.
 - 7. All latchbolts shall be deadlocking with 3/4" throw and have a self-lubricating coating to reduce friction and wear.
 - 8. Device shall bear UL label for fire and or panic as may be required.
 - 9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
 - 10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
 - 11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
 - 12. Furnish glass bead kits for vision lites where required.
 - 13. All Exit Devices to be sex-bolted to the doors.
 - 14. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.

- a. Provide exit devices UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware.
- E. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.
1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
 2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
 3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
 4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
 5. Closers shall be installed to permit doors to swing 180 degrees.
 6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
 7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
 8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.
- F. Electro-Mechanical Automatic Operators - LCN Senior Swing.
1. Requirements:
 - a. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19.
 - 1) Opening: Powered by DC motor working through reduction gears.
 - 2) Closing: Spring force.
 - 3) Manual, hydraulic, or chain drive closers: Not permitted.
 - 4) Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - 5) Cover: Aluminum.
 - b. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
 - c. Provide drop plates, brackets, or adapters for arms as required to suit details.
 - d. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
 - e. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for

each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

- 1) Actuators to comply with CBC 11B-404.3.5 Controls.
- f. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.
- G. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.
1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
 2. Provide dust proof strikes at openings using bottom bolts.
- H. Door Stops:
1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
 2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
 3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- I. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.
- J. Thresholds: As Scheduled and per details.
1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
 2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
 3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
 4. Thresholds shall comply with CBC Section 11B-404.2.5.
- K. Seals: Provide silicone gasket at all rated and exterior doors.
1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
 2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
 3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.
- L. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.
- M. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.02 KEYING

- A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combined by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.
- B. Extend the original Schlage masterkey system established for Merritt College
- C. Furnish all cylinders in the Patent Protected Schlage Small Format Interchangeable Core. (SFIC) "Everest B" family of keyways. Pack change keys independently (PKI)
 - 1. Confirm keyway with PCCD prior to ordering
- D. Furnish construction keying for doors requiring locking during construction.
 - 1. For SFIC systems provide 80-035 Small Format Construction Cores in either "BRN" or "GRN" combination for all locks that need to be locked during construction and M204-152 Disposable Cores for all cylinders not required to be locked.
 - 2. For SFIC systems provide ten 48-310 Const. Keys in either "BRN" or "GRN" combination to match cores in # 1 above.
 - 3. For SFIC systems provide two 48-311 Control Keys in either "BRN" or "GRN" combination to match cores in # 1 above. (const.)
 - 4. For SFIC systems provide two control keys for installing the permanent cores (either 48-311 for non-patented keyways or 49-356 for patented keyways such as "Everest -B" family)
- E. Furnish all keys with visual key control. *(Not all options listed below are*
 - 1. Stamp key "Do Not Duplicate".
 - 2. Stamp (BHMA) key symbol on key.
- F. Furnish all cylinders with visual key control.
 - 1. Stamp (BHMA) key symbol on side of cylinder (CKC).
- G. Furnish mechanical keys as follows:
 - 1. Furnish 2 cut change keys for each different change key code.
 - 2. Furnish 1 uncut key blank for each change key code.
 - 3. Furnish 6 cut masterkeys for each different masterkey set.
 - 4. Furnish 3 uncut key blanks for each masterkey set.
 - 5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
 - 6. Furnish 1 cut control key cut to each SKD combination.
- H. Furnish Schlage Padlocks and the cylinders to tie them into the masterkey system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.
 - 1. Furnish KS41D1200 padlock for use with SFIC Schlage cylinders. Furnish 80-037 (Everest-B) with above.
- I. Furnish one Schlage cabinet lock for each cabinet door or drawer so designated on the drawings or keying schedule to match the masterkey system.
 - 1. Furnish CL721G for use with SFIC Schlage cylinders.

2.03 FINISHES

- A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.
- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.04 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- H. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.

- I. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
- J. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
- K. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.
- L. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.03 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.04 HARDWARE LOCATIONS

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.05 FIELD QUALITY CONTROL

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.06 SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called

to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

DAC	=	DAC Industries	Butterfly Gate Latch
FIN	=	Fingersafe	Fingerguard
GLY	=	Glynn-Johnson Corporation	Overhead Door Stops
IVE	=	Ives	Hinges, Pivots, Bolts, Coordinators, Dust Proof Strikes, Push Pull & Kick Plates, Door Stops & Silencers
JOH	=	L.E. Johnson	Sliding Door Hardware
LCN	=	LCN	Door Closers, Auto Operators, Actuators
LOC	=	Locinox	Gate hinge
RIC	=	Richard Wilcox	Cane Bolt
SCE	=	Schlage Electronics	Electronic Door Components
SCH	=	Schlage Lock Company	Locks, Latches & Cylinders
STA	=	Stanley	Gate Hinges
VON	=	Von Duprin	Exit Devices
WIK	=	Wikk Industries	Bollard, Actuator
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

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GROUP NO. 01

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	VANDL CLASSROOM SEC	ND95BD RHO XN12-035	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 02

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	VANDL STOREROOM LOCK	ND96BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	LOCK GUARD	LG12	US32D	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 03

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	PA-AX-99-NL	626	VON
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 04

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-99-NL	626	VON
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)	ANCLR	LCN
2	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER
			CARD READER - WORK OF		
			DIVISION 28		
			DOOR CONTACT - WORK OF		
			DIVISION 28		
			POWER SUPPLY - WORK OF		
			DIVISION 28		

GROUP NO. 05

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	VANDL CLASSROOM LOCK	ND94BD RHO	626	SCH
1	EA	SFIC MORTISE CYL.	80-302 EV B	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	630	VON
1	EA	SURF. AUTO OPERATOR	9531 MS AS REQ (120/240 VAC)	ANCLR	LCN
2	EA	ACTUATOR, TOUCH	S-136-3-INGRESS'R	628	WIK
1	EA	BOLLARD	SQ8 - B-6SQ-RT-CL-SM-INGR	628	WIK
1	EA	FLOOR STOP	FS439	682	IVE
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	PER DETAIL		ZER
1	EA	KEY SWITCH	653-1414 L2 12/24 VDC	630	SCE

INSIDE ACTUATOR TURNED OFF VIA KEYSWITCH WHEN DOOR IS LOCKED.

GROUP NO. 06

2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-PA-3349A-EO 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-PA-3349A-NL-OP-388 24 VDC	626	VON
1	EA	SFIC MORTISE CYL.	80-302 EV B	626	SCH
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
2	EA	LONG DOOR PULL	9264 36" 20" O	630-316	IVE
1	EA	CONC. AUTO OPERATOR	2853 STD/OP2 MS120V / 240V AC	ANCLR	LCN
2	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	CUSTOM BOLLARD	SQ SERIES 6"X 6" PREPPED FOR 8310-836T, CARD READER, KEY SWITCH, INTERCOM AND EMERGENCY BUTTON	628	WIK
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	SET	SEAL SET	WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	PER DETAIL		ZER
1	EA	KEY SWITCH	653-1414 L2 12/24 VDC CARD READER - WORK OF DIVISION 28 WIRING DIAGRAM DOOR CONTACT - WORK OF DIVISION 28 POWER SUPPLY - WORK OF DIVISION 28	630	SCE

GROUP NO. 07

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-PA-AX-99-L-E996-06-FS 24 VDC	626	VON
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
			CARD READER - WORK OF DIVISION 28		
			DOOR CONTACT - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 08

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	CDSI-PA-AX-99-NL	626	VON
1	EA	SFIC MORTISE CYL.	80-302 X XQ11-948 EV B	626	SCH
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	VIEWER	U698 (INSTALL AT 40" AND 58" AFF)	626	IVE

GROUP NO. 09

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-99-L-BE-F-06	626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 10

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-99-L-BE-F-06	626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 11

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 12

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK OR BY FRAME MFR	BK	ZER

GROUP NO. 13

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS40	US26D	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 14

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE

GROUP NO. 15

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL OFFICE LOCK	ND91BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	FLOOR STOP	FS439	682	IVE

GROUP NO. 16

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95BD RHO XN12-035	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS439	682	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	FINGER GUARD	MK1A X MK1-B	TBD	FIN

GROUP NO. 17 - NOT USED

GROUP NO. 18

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95BD RHO XN12-035	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	VIEWER	U698 (INSTALL AT 40" AND 58" AFF)	626	IVE

GROUP NO. 19

3	EA	CONT. HINGE	224XY	628	IVE
1	EA	VANDL CLASSROOM SEC	ND95BD RHO XN12-035	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	FLOOR STOP	FS439	682	IVE

GROUP NO. 20

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95BD RHO XN12-035	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 21

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

GROUP NO. 22

2	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	EA	VANDL EU STOREROOM	ND96BDEU RHO RX 12V/24V DC	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
			CARD READER - WORK OF DIVISION 28		
			DOOR CONTACT - WORK OF DIVISION 28		
			POWER SUPPLY - WORK OF DIVISION 28		

GROUP NO. 23

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR BOTTOM	355AA	AA	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 24 - NOT USED

GROUP NO. 25

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96BD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 26

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	OFFICE W/SIM RETRACT	L9056BD 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 27

1	EA	PANIC HARDWARE	CDSI-PA-AX-33A-L-06-1439	626	VON
1	EA	CYLINDER	80-XXX EV B TYPE AS REQUIRED BY DOOR MFR	626	SCH
1	EA	SFIC MORTISE CYL.	80-302 EV B	626	SCH
1	EA	SFIC MORTISE CYL.	80-302 X XQ11-948 EV B	626	SCH
1	EA	TOP JAMB MOUNT TRACK CLOSER	TS9315 STH W/ DROP PLATE AS REQ FOR TOP RAIL OF DOOR DOOR CONTACT - WORK OF DIVISION 28 BALANCE OF HARDWARE BY NANAWALL	689	DRM

GROUP NO. 28 - NOT USED

GROUP NO. 29

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-99-L-NL-06	626	VON
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 30

2	EA	GATE HINGE	BB855A 5" X 6" OR BY GATE FABRICATOR	600	STA
1	EA	DBL CYL DEADBOLT	B662HD	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH

GROUP NO. 31

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95BD RHO XN12-035	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	VIEWER	U698 (INSTALL AT 40" AND 58" AFF)	626	IVE

GROUP NO. 32

1	SET	SELF CLOSING HINGE	MAMMOTH 180		LOX
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD-WH	630	VON
1	EA	SFIC MORTISE CYL.	80-302 X XQ11-948 EV B	626	SCH
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O	630-316	IVE

GROUP NO. 33

4	EA	GATE HINGE	BB855A 5" X 6" OR BY GATE FABRICATOR	600	STA
1	EA	CANE BOLT	0524.00021	Z	RIC
1	EA	ADA BUTTERLY LATCH	WALK GATE STRONG ARM MODIFIED WITH ADA COMPLIANT FLANGE BY CALCO		DAC

GROUP NO. 34

2	EA	GATE HINGE	BB855A 5" X 6" OR BY GATE FABRICATOR	600	STA
1	EA	CANE BOLT	0524.00021	Z	RIC
1	EA	ADA BUTTERLY LATCH	WALK GATE STRONG ARM MODIFIED WITH ADA COMPLIANT FLANGE BY CALCO		DAC

GROUP NO. 35

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-99-L-NL-F-06	626	VON
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 36

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	DOOR PULL, 1" ROUND	PR 8103EZHD 8" N	630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS439	682	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	FINGER GUARD	MK1A X MK1-B	TBD	FIN

GROUP NO. 37

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	PA-AX-99-L-BE-06	626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 38

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-99-L-2SI-06	626	VON
2	EA	RIM CYLINDER	80-329 EV B	626	SCH
2	EA	SFIC EVEREST CORE	80-037 EV B	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

GROUP NO. 39

1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-99-NL	626	VON
1	EA	RIM CYLINDER	80-329 EV B	626	SCH
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)	ANCLR	LCN
2	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER
			CARD READER - WORK OF		
			DIVISION 28		
			DOOR CONTACT - WORK OF		
			DIVISION 28		
			POWER SUPPLY - WORK OF		
			DIVISION 28		

END OF SECTION

SECTION 08 8000**GLAZING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Insulating glass units.
- B. Monolithic glass units.
- C. Glazing compounds.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.
 - 3. Convene under general provisions of Section 01 7000.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data on Insulating Glass Unit and Monolithic Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
 - 2. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
 - 3. Samples: Submit two samples 12 by 12 inch (300 by 300 mm) in size.
 - 4. Samples: Submit 2 inch (50 mm) long bead of glazing sealant, color as selected.
- B. Informational Submittals:
 - 1. Certificate: Certify that products of this section meet or exceed specified requirements.
 - 2. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 3. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), and IGMA TM-3000 for glazing installation methods.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
- D. Engineer Qualifications: Registered professional engineer licensed to practice structural engineering, with minimum of 5 years experience in design of glass and glazing.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- F. Certifications:
 1. Manufacturer's letter certifying glass and glazing materials compatibility.
 2. Manufacturer's letter certifying that sealed insulating glass units meet or exceed specification.
 3. Engineering certifications.

1.06 MOCK-UPS

- A. Mock-ups: Build mock-ups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 1. Install glazing in mock-ups specified in Section 08 4313 Aluminum-Framed Entrances and Storefronts to match glazing systems required for Project, including glazing methods.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Provide on-site glazing mock-up with the specified glazing components.
- C. Locate where directed.
- D. Mock-ups may remain as part of the Work.

1.07 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 3. Test no fewer than 8 samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions for shipping, handling, storing, and protection of glass and glazing materials. Exercise exceptional care to prevent edge damage to glass, and damage to coatings.
- B. Where insulating glass units will be exposed to substantial altitude changes during shipping, comply with manufacturer's recommendations for venting and sealing.

1.09 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

- C. Install sealants only when ambient temperature conditions can be maintained at or above 40 degrees F (4 degrees C) during installation and 48 hours immediately following installation.

1.10 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a 10 year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
 - 1. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 Quality Requirements, to design glazing.
- C. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7.
 - 4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 5. Glass thicknesses listed are minimum.
 - 6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 - a. Refer to Section 07 2500 - Weather Barriers.
- E. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 - 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.02 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, and at locations required by code, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

- A. Insulating Glass Units: Types as indicated.
 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Metal Edge Spacers: Aluminum, bent and soldered corners.
 3. Spacer Color: Black.
 4. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 5. Color: Black.
 6. Purge interpane space with dry argon, hermetically sealed.
- B. GL-31 Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated. Fully tempered where required by code.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Laminated float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 7. Visible Light Transmittance (VLT): 54 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 28 percent, nominal.
 9. Visible Light Reflectance, Outside: 13 percent, nominal.
 10. Visible Light Reflectance, Inside: 18 percent, nominal.
 11. Glazing Method: Dry glazing method, gasket glazing.

12. Basis of Design Product:
 - a. Guardian Glass, LLC.; Superneutral 54
 - b. Approved equal.

- C. GL-32 Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated. Fully tempered where required by code.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Laminated, patterned float glass, No. 4 surface, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear,
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 7. Visible Light Transmittance (VLT): 54 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 28 percent, nominal.
 9. Visible Light Reflectance, Outside: 13 percent, nominal.
 10. Visible Light Reflectance, Inside: 18 percent, nominal.
 11. Glazing Method: Dry glazing method, gasket glazing.
 12. Basis of Design Product:
 - a. Guardian Glass, LLC; Superneutral 54 with Berman Esto pattern glass in horizontal orientation.
 - b. Approved equal.

- D. GL-33 Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated. Fully tempered where required by code.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Laminated float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 7. Visible Light Transmittance (VLT): 54 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 28 percent, nominal.
 9. Visible Light Reflectance, Outside: 13 percent, nominal.
 10. Visible Light Reflectance, Inside: 18 percent, nominal.
 11. Glazing Method: Dry glazing method, gasket glazing.
 12. Basis of Design Product:
 - a. Guardian Glass, LLC.; Superneutral 54
 - b. Approved equal.

- E. GL-34 Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated. Fully tempered where required by code.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Laminated float glass with ceramic frit, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Ceramic Frit Pattern: 1/8 inch (3.17 mm) wide white horizontal stripes at 1/4 inch (6.35 mm) on center.

- 1) Surface: No. 3.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 7. Visible Light Transmittance (VLT): 54 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 28 percent, nominal.
 9. Visible Light Reflectance, Outside: 13 percent, nominal.
 10. Visible Light Reflectance, Inside: 18 percent, nominal.
 11. Glazing Method: Dry glazing method, gasket glazing.
 12. Basis of Design Product:
 - a. Guardian Glass, LLC.; Superneutral 54
 - b. Approved equal.
- F. GL-35 Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated. Fully tempered where required by code.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Laminated, patterned float glass, No. 4 surface, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear,
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 7. Visible Light Transmittance (VLT): 54 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 28 percent, nominal.
 9. Visible Light Reflectance, Outside: 13 percent, nominal.
 10. Visible Light Reflectance, Inside: 18 percent, nominal.
 11. Glazing Method: Dry glazing method, gasket glazing.
 12. Basis of Design Product:
 - a. Guardian Glass, LLC; Superneutral 54 with Berman Esto pattern glass in horizontal orientation.
 - b. Approved equal.

2.05 MONLITHIC GLAZING UNITS

- A. GL-11 - Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 3/8 inch (10 mm), nominal.
- B. GL-12 - Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Fully tempered float glass.
 3. Tint: Clear.
 4. Thickness: 3/8 inch (10 mm), nominal.
- C. GL-15 - Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Fully tempered; monolithic glass system.
 3. Tint: Clear.
 4. Thickness: 1/2 inch (13 mm), nominal.
- D. Type GL-13 - Direct to Glass Ceramic Printing: Ceramic frit is fused into glass creating permanent designs.
 1. Glass Type: Fully tempered; monolithic glass system.
 2. Thickness: 3/8 inch (10 mm), nominal.

3. Ceramic Frit Pattern: 1/8 inch (3.17 mm) wide white horizontal stripes at 1/4 inch (6.35 mm) on center.
 - a. Surface: No. 2.
 - b. Location: 24 inches (610 mm) above finish floor to 72 inches (1829 mm) above finish floor.

2.06 LAMINATED GLASS

- A. GL-21 - Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Laminated float glass.
 3. Tint: Clear.
 4. Thickness: 3/8 inch (10 mm), nominal.
 - a. Two lites of 3/16 inch (5 mm) glass.
 5. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
 - a. Color/Pattern: Clear.
- B. GL-22 - Monolithic Interior Vision Glazing:
 1. Applications: Exterior glazing unless otherwise indicated.
 2. Glass Type: Laminated, heat-strengthened float glass.
 3. Tint: Clear.
 4. Thickness: 1/2 inch (13 mm), nominal.
 - a. Two lites of 1/4 inch (6 mm) glass.
 5. Ionoplast Interlayer: 0.035 inch (0.889 mm) thick, minimum.
 - a. Color/Pattern: Clear.
- C. GL-23 - Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Laminated float glass.
 3. Tint: Clear.
 4. Thickness: 3/8 inch (10 mm), nominal.
 - a. Two lites of 3/16 inch (5 mm) glass.
 5. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
 - a. Color/Pattern: Clear.
 6. Ceramic Frit Pattern: 1/8 inch (3.17 mm) wide white horizontal stripes at 1/4 inch (6.35 mm) on center.
 - a. Surface: No. 2.
 - b. Location: 24 inches (610 mm) above finish floor to 72 inches (1829 mm) above finish floor.
- D. GL-24 - Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Laminated float glass.
 3. Tint: Clear.
 4. Thickness: 3/8 inch (10 mm), nominal.
 - a. Two lites of 3/16 inch (5 mm) glass.
 5. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
 - a. Color/Pattern: Clear.
 6. Ceramic Frit Pattern:
 - a. Surface: No. 2.

E.

2.07 GLAZING COMPOUNDS

- A. General Requirements:
 1. Provide black exposed glazing accessory materials, unless specifically indicated otherwise.
 2. Provide materials of hardness as recommended by manufacturer for required application and condition of installation in each case. Provide only compounds which are known to be fully

compatible with surfaces contacted, including glass products, seals, and glazing channel surfaces.

3. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 , CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-GreenTable 5.504.4.2 Sealant VOC Limit requirements.
 - a. Current requirement refers to the date on which the materials are installed in the building.
 - b. A copy of SCAQMD 1168 is referenced in Section 018114 - Greenhouses that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
 4. Comply with volatile organic compound (VOC) product requirements specified in Section 018114 - Greenhouses.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; clear.

2.08 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 1. Width: As required for application.
 2. Thickness: As required for application.
 3. Spacer Rod Diameter: As required for application.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glass Standoffs: Fabricated from stainless steel ASTM A 666, 304 Alloy.
 1. Holes for Glass Attachment: 5/8 inch (16 mm) hole per attachment.
 2. Standoff: 1-1/2 inch diameter by 2 inches in length.
 3. Cap: Manufacture's standard cap.
 4. Washers" Vinyl.
 5. Finish: No. 4 Brushed.
 6. Basis of Design Product:
 - a. C.R. Laurence Co., Inc.; CRL 1-1/2" Diameter x 2" Long Stainless Standoff Bases: www.crlaurence.com.

2.09 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

- a. Differential values in "Temperature Change" Subparagraph below (for aluminum in particular) are suitable for most of the United States.
- b. Temperature Change: 120 deg F (50 deg C), ambient; 180 deg F (82 deg F), material surfaces.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 08 9100

LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
 2. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
 3. Samples for Initial Selection: Submit three samples for units with factory-applied color finishes.
 4. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finish and color of exterior and interior surfaces.
- B. Informational Submittals
 1. Test Reports: Independent agency reports showing compliance with specified performance criteria.
 2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Closeout Submittals
 1. Maintenance Data: Include lubrication schedules, adjustment requirements.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.05 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 LOUVERS

- A. Refer to Exterior Material Schedule for selected products and finishes.
- B. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load as required by code without damage or permanent deformation.
 - 2. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
- C. Stationary Louvers: Horizontal blade, extruded aluminum construction.
 - 1. Free Area: 51 percent, minimum.
 - 2. Blades: Drainable V-shaped blade with front gutter for water diversion to jambs.
 - 3. Frame: 5 inches deep (127 mm deep), channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
 - 4. Aluminum Thickness: Frame 12 gage, 0.0808 inch (2.05 mm) minimum; blades 12 gage, 0.0808 inch (2.05 mm) minimum.
 - 5. Aluminum Finish: Superior performing organic coatings; finish welded units after fabrication.
 - 6. Basis of Design Product:
 - a. Airolite Company, LLC (The).; Airolite K605: www.airolite.com.
 - b. Other Acceptable Manufacturers:
 - 1) Air Flow Company, Inc.
 - 2) Architectural Louvers
 - 3) Construction Specialties, Inc: www.c-sgroup.com.
 - 4) Greenheck Fan Corporation.
 - 5) Ruskin Company.
 - 6) Approved equal.

2.02 MATERIALS

- A. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- B. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 ACCESSORIES

- A. Insect Screen: 16 x 1 size steel mesh, 0.04 inch (1.0 mm) wire.
- B. Fasteners and Anchors: Stainless steel.
- C. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- D. Sealant as specified in Section 07 9200 - Joint Sealants.

2.04 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Tube unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide subsills made of same material as louvers for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds , threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.05 FINISHES

- A. Superior Performing Organic Coatings: AAMA 2605 two coat, thermally cured polyvinylidene fluoride system.
 - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 1.2 mil (0.03 mm).
 - 2. Color: as selected by Architect from manufacturer’s full range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Set sill members and sill flashing in continuous bead of sealant.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

- E. Secure louver frames in openings with concealed fasteners.
- F. Form closely fitted joints with exposed connections accurately located and secured.
- G. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- H. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- I. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.
- J. Coordinate with installation of mechanical ductwork.

3.04 ADJUSTING

- A. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.05 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION

SECTION 09 0561

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile flooring.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Perform specified remediation of concrete floor slabs.
 - 2. Contractor shall perform specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- E. Patching compound.
- F. Remedial floor coatings.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - a. Manufacturer's qualification statement.
 - b. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - c. Manufacturer's installation instructions.
 - d. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
 - 2. Visual Observation Report: For existing floor coverings to be removed.
 - 3. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - a. Moisture and alkalinity (pH) limits and test methods.
 - b. Manufacturer's required bond/compatibility test procedure.
 - c. Product Test Reports: For each MVE-control system, for tests performed by a qualified testing agency.
- B. Informational Submittals:
 - 1. Testing Agency's Report:
 - a. Description of areas tested; include floor plans and photographs if helpful.
 - b. Summary of conditions encountered.
 - c. Moisture and alkalinity (pH) test reports.
 - d. Copies of specified test methods.

- e. Recommendations for remediation of unsatisfactory surfaces.
 - f. Product data for recommended remedial coating.
 - g. Include certification of accuracy by authorized official of testing agency.
 - h. Submit report to Architect.
 - i. Submit report not more than two business days after conclusion of testing.
2. Adhesive Bond and Compatibility Test Report.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 5. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.
 - 6. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.

1.05 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. ICRI certified independent testing agency.
 - 2. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).

- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.
- C. Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F (18 deg C) and not more than 85 deg F (29 deg C) at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C) and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F (- 15 deg C) higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
 - 1. Adhesive shall meet VOC and chemical component limits of SCAQMD 1168 and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.
- C. Remedial Floor Coating: ASTM F3010 qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
 - 1. Thickness: 1/8 inch (3.2 mm), maximum.
 - 2. If testing agency recommends any particular products, use one of those.
 - 3. Acceptable Products:
 - a. ARDEX Engineered Cements; ARDEX MC ULTRA with ARDEX FEATHERFINISH: www.ardexamericas.com.
 - b. Koster American Corporation; Koster VAP I 2000 with Koster SL Premium overlay: www.kosterusa.com.
 - 4. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
 - 5. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.02 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000 psi (20.68 MPa) compressive strength after 28 days when tested according to ASTM C109/C109M.

- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's gypsum cement-based underlayment.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Preinstallation Testing:
 - 1. Testing Agency: Engage a qualified testing agency to perform tests.
 - 2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
 - 4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. (9.29-sq. m) area of MVE-control system to prepared concrete substrate and test according to ASTM D 7234.
 - a. Proceed with installation only where tensile bond strength is greater than 200 psi (1.38 MPa) with failure in the concrete.
- C. Perform following operations in the order indicated:
 - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 - 2. Preliminary cleaning.
 - 3. Anhydrous calcium chloride test; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
 - 4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 6. Specified remediation, if required.
 - 7. Patching, smoothing, and leveling, as required.
 - 8. Other preparation specified.
 - 9. Adhesive bond and compatibility test.
 - 10. Protection.
- D. Remediations:
 - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that

adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.

3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.
- E. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
 2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
 4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
 5. Fill surface depressions and irregularities with patching and leveling material.
 6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
 7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
 8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.
- F. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP) Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.04 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.05 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.06 APPLICATION OF REMEDIAL FLOOR COATING

- A. If required as a result of testing apply remedial floor coating.
- B. Comply with requirements and recommendations of coating manufacturer.
- C. General: Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
 - 1. Install primers as required to comply with manufacturer's written instructions.
- D. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- E. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- F. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- G. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- H. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 - 1. Verify that surface preparation meets requirements.
 - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

3.08 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.
- C. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Security mesh reinforcing in wall assemblies.
- D. Cementitious backing board.
- E. Gypsum board.
- F. Impact-resistant wallboard.
- G. Joint treatment and accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with mechanical and electrical work. Do not attach or support metal framing to ducts, pipes, conduit, or similar items.
 - 2. Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.
 - 3. Coordinate gypsum board work with requirements of Section 07 8400 - Firestopping to maintain integrity of fire-rated and smoke-rated partitions required to comply with specified regulatory requirements.

1.03 SUBMITTALS

- A. Action Submittals
 - 1. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
 - 2. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
 - 3. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
 - 4. Samples: Submit Three samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, illustrating finish color and texture.
- B. Informational Submittals
 - 1. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.
- B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Stud Framing: Products that do not comply with ASTM C645 or C754 are not permitted.

1.06 MOCK-UP

- A. Mock-up: Construct gypsum board system mock-up where indicated on the Drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on the Drawings.
 - 2. Approved mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products in accordance with referenced standards.
- B. Handle gypsum boards to prevent damage to ends, edges, and surfaces.

1.08 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Maintain ambient temperatures at not less than 50 deg F (10 deg C) for a period 48 hours before gypsum board finishing, during installation, and after installation of board materials.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLY PERFORMANCE REQUIREMENTS

- A. Design Requirements: Contractor is responsible for designing metal framing used to comply with performance requirements, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
- B. Performance Requirements:
 - 1. Interior Suspended Gypsum Board Ceilings, Soffits, and Bulkheads: Design and install to provide deflection of not more than 1/360 of distance between supports.
 - 2. Interior Metal Stud/Gypsum Board Assemblies: Design and install to withstand lateral loading (air pressure) of 5 PSF with deflection limit not more than 1/240 of partition height.
 - 3. Interior Metal Stud/Gypsum Board Assemblies at Locations with Ceramic Tile or Other Hard Surface Finishes: Design and install to withstand lateral loading (air pressure) with deflection limit not more than L/360 of partition height.
 - 4. Where documents indicate a stud size, size shall be considered minimum. Increase gage to meet minimum performance requirements.
 - 5. Accommodate building structure deflections in connections to structure.

- C. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
 - 1. Construct assemblies identical to those indicated by reference to GA 600 or to design designations listed by Factory Mutual, Underwriters Laboratories, Warnock Hersey, or listing of other agencies acceptable to authorities having jurisdiction.
 - 2. Provide partition head assemblies for fire-rated full height partitions that have been successfully tested to accommodate deck deflection.
- D. Provide completed assemblies complying with ASTM C840 and GA-216.
- E. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
 - 2. Provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- F. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- G. Fire Rated Assemblies: Provide completed assemblies specified on Drawings.
 - 1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
 - 2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
 - 3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
 - 4. Where any specified rated assembly requires the use of proprietary gypsum board system products, installation methods or procedures, comply with specified rated assembly requirements including requirements associated with assembly options which may be selected by Contractor.

2.02 METAL FRAMING MATERIALS

- A. Acceptable Manufacturers:
 - 1. Angeles Metal Systems
 - 2. ClarkDietrich Building Systems LLC: www.clarkdietrich.com.
 - 3. CEMCO; California Expanded Metal Company: www.cemcosteel.com.
 - 4. Marino: www.marinoware.com.
 - 5. SCAFECO Corporation: www.scafco.com.
- B. Metal Framing - General: Provide framing materials complying with specified standards and tested assemblies; galvanized sheet steel, 20 gage unless specified, noted, scheduled, or detailed otherwise.
- C. Metal Stud Framing System Components - Non-Loadbearing: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/360 at 10 psf (480 Pa).
 - 1. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
 - 2. Refer to Drawings for stud sizes.
 - 3. Studs: "C" shaped with flat or formed webs.
 - a. Type 25:
 - 1) Return flange lip minimum dimension: 3/16 inch (5 mm).

- 2) Flange width minimum dimension: 1-1/4 inch (31.75 mm).
- 3) Uncoated sheet steel thickness: 0.0179 inches (0.45 mm).
- b. Type 22:
 - 1) Return flange lip minimum dimension: 3/16 inch (5 mm).
 - 2) Flange width minimum dimension: 1-1/4 inch (31.75 mm).
 - 3) Uncoated sheet steel thickness: 0.0270 inches (0.65 mm).
- c. Type 20:
 - 1) Return flange lip minimum dimension: 3/16 inch (5 mm).
 - 2) Flange width minimum dimension: 1-1/4 inch (31.75 mm).
 - 3) Uncoated sheet steel thickness: 0.0329 inches (0.83 mm).

STUD SIZE	MAXIMUM HEIGHT, FEET			DESIGN BASED ON SSMA SIZE
	SPACING, INCHES			
	12	16	24	
3 5/8" x 25 gauge	13'-8"	12'-5"	10'-10"	350S125-18
3 5/8" x 20 gauge	18'-5"	16'-9"	14'-7"	362S137-33
6" x 20 gauge	27'-5"	24'-11"	21'-9"	600S137-33
8" x 20 gauge	34'-8"	31'-6"	27'-6"	800S137-33

- 4. Bracing Members: Size as required to meet design requirements, same size as studs, minimum.
 - 5. Runners: U shaped, sized to match studs.
 - 6. Ceiling Channels: C-shaped.
 - 7. Cold-Rolled Furring Channels: 0.053 inch (1.35 mm) uncoated-steel thickness, with minimum 1/2 inch (12.70 mm) wide flanges.
 - a. Depth: 7/8 inch.
 - b. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.84 mm).
 - c. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062 inch (1.57 mm) diameter wire, or double strand of 0.048 inch (1.22 mm) diameter wire.
 - 8. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm), ASTM C645.
 - a. Minimum Base-Metal Thickness: As indicated on Drawings.
 - 9. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - a. Minimum Base-Metal Thickness: 0.097 inch .
 - b. Width: 8 inches (203.20 mm).
 - 10. Hat-Shaped, Rigid Furring Channels: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm)
 - b. Depth: As indicated on Drawings
 - 11. Resilient Furring Channels: 1/2 inch (12 mm) depth, for attachment to substrate through one leg only.
 - a. Acceptable Manufacturers - Resilient Furring Channels:
 - 1) Dietrich; RC Deluxe.
 - 2) No substitutions
- D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- 1. Acceptable Manufacturers - Shaft Wall Studs and Accessories:
 - a. Same manufacturer as other framing materials.
- E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Stud System Accessories: Manufacturer's standard clips, shoes, ties, reinforcements, fasteners, and other accessories as required for a complete stud framing system.

- G. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI SG02-1.
 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
 3. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
 - b. Acceptable Products:
 - 1) ClarkDietrich Building Systems; SLP-TRK Slotted Deflection Track.
 - 2) Fire Trak Corp; Posi Clip.
 - 3) MBA Building Supplies; Slotted Deflecto Track.
 - 4) Steel Network, Inc. (The); VertiClip SLD.
 - 5) Telling Industries; Vertical Slip Track.
 - 6) Substitutions: See Section 01 6000 - Product Requirements.
 4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on Drawings; minimum track length of 12 feet (3660 mm).

2.03 CEILING SUSPENSION SYSTEM COMPONENTS

- A. Gypsum Board Interior Ceiling Suspension System:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for conditions and spacing required.
 2. Ceiling Hanger Wire: ASTM A641/A641M, Class 1 coating; soft temper, pre-stretched, yield stress load at least three times design load, but not less than 12 gage.
 3. Ceiling Hanger Angles: Not less than 7/8 inch (22.22 mm) by 7/8 inch (22.22 mm) by 16 gage, 0.0508 inch (1.29 mm) galvanized steel formed angles; ASTM A653/A653M, G90 coating, with minimum 5/16 inch (7.94 mm) diameter bolted connections.
 4. Ceiling Hanger Anchors: Size for three times imposed loads, as determined by ASTM E488/E488M; corrosive resistant materials with loops or holes for attachment of hanger wires.
- B. Ceiling Attachment Devices:
1. General:
 - a. Size devices for 5 times load imposed by completed system as determined in accordance with ASTM E488/E488M.
 - b. Powder-actuated fasteners in concrete: Size devices for 10 times load imposed by completed system as determined in accordance with ASTM E1190.
 2. Hanger Anchorage Devices: Screws, clips, bolts, inserts or other devices applicable to indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven by certified test data.
 3. Hangers: Comply with requirements of ASTM C754 for maximum ceiling area and loads to be supported.
- C. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock, Fire Rated.
1. Acceptable Products:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - 1) Approvals:
 - (a) ICC-ES ESR-1289.
 - b. CertainTeed Ceilings; QuickSpan Locking Drywall Grid System: www.certainteed.com.
 - 1) Approvals:
 - (a) ICC-ES ESR-3336.
 - c. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension.
 - 1) Approvals:

- (a) ICC-ES ESR-2631.
- d. USG Corporation; Drywall Suspension System.
 - 1) Approvals:
 - (a) ICC-ES ESR-1222.
- e. Worthington Steel; DFR-Series Fire-Rated Drywall Furring System.
 - 1) Approvals:
 - (a) ICC-ES ESR-1308.

2.04 BOARD MATERIALS

- A. Acceptable Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Georgia-Pacific Building Products: www.gpgypsum.com.
 - 3. National Gypsum Company: www.nationalgypsum.com.
 - 4. PABCO Gypsum: www.pabco gypsum.com.
 - 5. USG Corporation: www.usg.com.
 - 6. American Gypsum Company: www.americangypsum.com.
- B. Board Materials - General:
 - 1. Maximize use of recycled or synthetic gypsum with minimum of 10 percent.
 - 2. Comply with ASTM C1396/C1396M.
 - 3. Type X or manufacturer's proprietary fire rated core for fire rated assemblies and locations where indicated; regular type at other assemblies.
 - 4. Maximum available lengths to minimize end-to-end butt joints, square cut ends, tapered edge.
 - 5. Thickness: 5/8 inch (15.87 mm), except where indicated otherwise
- C. Gypsum Board: Gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Applications: Use for vertical surfaces, unless otherwise indicated.
 - 2. Thickness: As indicated on Drawings.
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Multi-Layer Assemblies: Thicknesses as indicated on Drawings.
 - 3. Acceptable Mold-Resistant Paper-Faced Products:
 - a. Location: Tile backing panels, Toilet room areas without tile, and as indicated on Drawings.
 - b. Acceptable Products:
 - 1) American Gypsum Company; M-Bloc: www.americangypsum.com/#sle.
 - 2) Certainteed, Proroc Moisture And Mold Resistant With M2tech.
 - 3) National Gypsum Company; Gold Bond exp Tile Backer.
 - 4) USG, Sheetrock Brand Mold Tough.
 - 5) Prior approved equal.
- D. Gypsum Board Type X: Gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Applications: Use for fire rated vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Thickness: As indicated on Drawings.
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 5/8 inch (16 mm).
 - c. Multi-Layer Assemblies: Thicknesses as indicated on Drawings.
 - 3. Basis of Design Product:
 - a. National Gypsum Company; Gold Bond Fire-Shield Gypsum Board.
 - b. Approved equal.
- E. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
 - 1. Applications: Rated ceilings, unless otherwise indicated.
 - 2. Thickness: 5/8 inch (15.9 mm).

3. Long Edges: Tapered.
 4. Basis of Design Product:
 - a. American Gypsum; 5/8" FireBloc Type C Gypsum Wallboard.
 - b. CertainTeed Corporation; ProRoc Type C.
 - c. Georgia-Pacific Gypsum; Fireguard C.
 - d. National Gypsum Company; Gold Bond Fire-Shield C.
 - e. Pacific Coast Building Products, Inc.; Flame Curb Type Super C.
 - f. USG Corporation; USG Sheetrock Brand Firecode C Gypsum Panels.
- F. Backing Board For Tiled Areas:
1. Applications: Surfaces behind tile in wet areas including toilet rooms.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. ANSI Cement-Based Backing Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch (1.58 mm).
 - b. Acceptable Products:
 - 1) Custom Building Products Wonderboard: www.custombuildingproducts.com.
 - 2) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com.
 - 3) USG Corporation; Durock Cement Board: www.usg.com.
- G. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Applications: Ceilings, unless otherwise indicated.
 2. Thickness: 1/2 inch (13 mm).
 3. Edges: Tapered.
- H. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (610 mm) wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 2. Acceptable Paper-Faced Products:
 - a. American Gypsum Company; M-Bloc Shaft Liner: www.americangypsum.com/#sle.
 - b. CertainTeed Corporation; M2Tech Type X Shaftliner: www.certainteed.com/#sle.
 - c. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gpgypsum.com/#sle.
 - d. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP: www.nationalgypsum.com/#sle.
 - e. Pacific Coast Building Products, Inc.; PABCORE Gypsum Shaftliner Board type X.
 - f. USG Corporation; Gypsum Liner Panels.
 - g. Approved equal.

2.05 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: As specified in Section 09 8100 - Acoustic Insulation.
- B. Acoustic Sealant: As specified in Section 07 9219 - Acoustical Joint Sealants.
- C. Isolation Strip at Exterior Walls or as Indicated on Drawings: Provide the following:
 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
- D. Finishing Accessories: ASTM C1047, galvanized steel, unless otherwise indicated.
 1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide L-bead and LC-bead at exposed panel edges.
 3. Acceptable Manufacturers:
 - a. Same manufacturer as framing materials.

4. Control Joints: One-piece, v-grooved control joint with integral perforated flanges; removable tape to protect v-groove during finishing.
 - a. Applications: Locations specifically noted on Drawings; also located at internal corners, wall locations at re-entrant soffit corners, and ceiling locations at re-entrant soffit corners whether or not specifically noted on Drawings.
5. Reveal Trim: Aluminum extrusions; 1/2 inch wide reveal, 5/8 inch depth, integral perforated flanges.
 - a. Include required intersection, mitered corner, and termination trim accessories.
 - b. Basis of Design Product: 500 Series manufactured by Gordon, Inc.; www.gordonceilings.com.
 - c. Other Acceptable Manufacturers:
 - 1) Fry Reglet Corp.: www.fryreglet.com.
 - 2) MM Systems Corporation: www.mmsystemscorp.com.
 - 3) Pittcon Industries: www.pittconindustries.com.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners at glass mat panels.
 2. Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
 3. Board manufacturer's standard ready-mixed joint compounds low-VOC joint compounds with no detectable amounts of crystalline silica based on NIOSH Method 7500.
 4. Compounds specifically manufactured for topping coats are not permitted for first coat on metal trim and taping.
 5. Ready-mixed vinyl-based joint compound at indicated applications.
 6. Joint Treatment for Cementitious Backer Board: Minimum 2 inch wide open mesh glass fiber tape acceptable to board manufacturer and tile manufacturer.
- F. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
 1. Products:
 - a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfer with M2Tech: www.certainteed.com.
 - b. Hamilton Drywall Products; Prep-Coat Plus.
 - c. USG Corporation; USG Sheetrock Brand Tuff-Hide Primer-Surfer: www.usg.com.
 - d. Approved equal.
- G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
 1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
 2. Type G screws for gypsum board to gypsum board.
 3. Type W screws for wood framing; nails not permitted.
 4. Type S, S-12 or W steel screws used to attach panels to studs or furring channels:
 - a. Single Layer Systems: 1 inch (25 mm) long for 1/2 inch (12.70 mm) and 5/8 inch (15.87 mm) thick panels or 1-1/4 inches (31.75 mm) long for 3/4 inch (19.05 mm) thick panels, spaced 8 inches (203.20 mm) o.c. when panels are applied horizontally, or 8 inch (203.20 mm) o.c. along vertical and bottom edges and 12 inches (305 mm) o.c. in the field when panels are applied vertically.
 - b. Two Layer Systems:
 - 1) First Layer: 1 inch (25 mm) long for 1/2 inch (12.70 mm) and 5/8 inch (15.87 mm) thick panels or 1-1/4 inches (31.75 mm) long for 3/4 inch (19.05 mm) thick panels, spaced 16 inches (406.40 mm) o.c.
 - 2) Second layer: 1-5/8 inches (41.27 mm) long for 1/2 inch (12.70 mm), 5/8 inch (15.87 mm) thick panels or 2-1/4 inch (57.15 mm) long for 5/8 inch (15.87 mm)

thick panels, spaced 16 inches (406.40 mm) o.c. with screws offset 8 inches (203.20 mm) from first layer.

- H. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
 - 1. Product Type 1:
 - a. Hilti, Inc.; Hilti Low-Velocity Power-Actuated Fasteners.
 - b. Code Approvals:
 - 1) ICC ESR 1663.
 - 2) LARR 25646.
 - 2. Product Type 2:
 - a. Hilti, Inc.; Hilti Low-Velocity X-U and X-U 15 Universal Power-Actuated Fasteners.
 - b. Code Approvals:
 - 1) ICC ESR 2669.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this Section before commencing work of this Section.
- B. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- C. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- D. Verify rough-in utilities and blocking are in proper position.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Furnish concrete inserts, steel deck hanger clips, and similar devices to other trades for installation well in advance of time needed for coordination with other work.

3.03 SHAFT WALL INSTALLATION

- A. Shaft Wall Stud Framing: Install in accordance with GA-600 requirements.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
 - 2. Install studs at spacing required to meet performance requirements.
- B. Shaftwall Coreboard: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
 - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.
- C. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- D. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

- E. At elevator shafts where shaft system cannot be positioned within 2 inches (50.8 mm) of structural beams, floor edges and similar projections into shaft, provide 5/8 inch (15.87 mm) gypsum board cants to cover tops of projections. Slope not more than 15 degrees from vertical. Set base edge in drywall adhesive and secure top with screws at 24 inches (610 mm) on center maximum.
- F. Seal perimeter of shaftwall work where it abuts other work following requirements of Section 07 8400 - Firestopping for firestopping and fire-resistive joint sealant as applicable. Use exposed acoustic sealant at joints exposed to view on finished side.

3.04 FRAMING INSTALLATION

- A. Framing Systems: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Building Expansion Joints: Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other support as indicated.
- C. Suspended Ceilings and Soffits:
 - 1. Level ceiling and soffit system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
 - 3. Install bracing as required at exterior locations to resist wind uplift.
 - 4. Space ceiling framing and furring members 16 inches (400 mm) on center, except as otherwise indicated.
 - 5. Space ceiling framing and furring members at water-resistant gypsum board locations not to exceed 12 inches (300 mm) on center.
- D. Metal Stud Framing: Space studs as permitted by standard, or as specified below:
 - 1. Space studs 16 inches on center, except as otherwise indicated or required by specified tested assemblies, and secure to floor and ceiling runners with screws.
 - 2. Provide supplemental framing matching primary wall framing to support cut edges of gypsum boards not supported by primary vertical wall framing members.
 - 3. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 4. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling framing in accordance with details.
 - 5. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
 - 6. Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support free from axial loading. Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3.17 mm) from plane of faces of adjacent framing.
 - 7. At partitions supported by on-grade slabs, provide top slip joint to accommodate 2 inch (51 mm) vertical movement. Provide deflection tracks or firestop tracks at slip joints where specified, or detailed on Drawings.
 - 8. Where walls are indicated to extend to overhead surfaces (ceilings, deck construction, and structural elements), to prevent deflection transfer of structural loads or movements to walls provide either:
 - a. Insert studs into runner tracks with minimum 1/2 inch (12.70 mm) gap between end of stud and inside surface of top and bottom runner. Maintain minimum of 1/2 inch (12.70 mm) engagement between end of stud and end of legs of top and bottom runners.
 - b. Slip joint between walls and structure using top runner nested within 3 inch (76.20 mm) long segment of extended leg ceiling runner positioned at stud spacing and fastened to overhead surface. Do not fasten top runner to extended leg ceiling runner.
 - 9. Brace stud framing rigid which is not clad on both sides with gypsum board. Fasten horizontal stud or 1-1/2 inch (38 mm) wide 22 gage, 0.0299 inch (0.76 mm) galvanized steel straps vertically spaced no more than 36 inches (914 mm) apart with top strap no more than 6 inches from top of wall.

10. Horizontally align openings in stud webs.
 11. Use full length studs vertically positioned between runner tracks.
 12. Minimum Jamb Stud Framing at Door Openings:
 - a. Walls laterally braced by ceiling framing or structure at 9'-0" (2743 mm) above finish floor:
 - 1) Single Doors not Larger than 3'-6" (1066.8 mm) by 9'-0" (2743 mm) and not Weighing more than 275 Pounds: 2 Type 25 studs or 1 Type 20 stud.
 - 2) Paired Doors not Larger than 3'-6" (1066.8 mm) by 9'-0" (2743 mm) per leaf and not Weighing more than 275 Pounds per Leaf: 2 Type 20 studs or 1 Type 18 stud.
 - b. Walls Laterally Braced by Ceiling Framing or Structure at 12'-0" (3658 mm) above Finish Floor:
 - 1) Single Doors not Larger than 3'-6" (1066.8 mm) by 9'-0" (2743 mm) and not Weighing More than 275 Pounds: 2 Type 20 studs or 1 Type 18 stud.
 - 2) Paired doors not larger than 3'-6" (1066.8 mm) by 9'-0" (2743 mm) per leaf and not weighing more than 275 Pounds per leaf: 2 Type 18 studs.
 - c. At welded frames with fixed anchor clips, secure studs to jamb anchors clips with not less than two self tapping screws per clip.
 - d. Provide wall framing above door openings to match wall framing adjoining the opening.
 - e. Provide one additional stud not more than 6 inches (150 mm) from jamb studs.
 - f. At fire-rated doors use minimum thickness of Type 20 studs, unless otherwise indicated.
 - g. Comply with GA-219 for fire-rated doors.
 13. Minimum Sidelight Framing:
 - a. Provide 2 Type 25 studs at each jamb or provide 1 Type 20 stud at each jamb.
 - b. Provide wall framing above and below window and wall openings with wall framing to match wall framing adjoining the opening.
 - c. Provide 1 additional stud not more than 6 inches (150 mm) from jamb studs.
 14. Fabricate corners with a minimum of three studs.
 15. Provide additional studs and framing to support wall intersections, termination of walls, at openings and cut-outs and to support built-in anchorage and attachment devices for other work.
 16. Locate studs no more than 2 inches (50.8 mm) from abutting walls, wall corners and other construction. Start typical wall studs 6 inches (150 mm) either side of stud reinforcing or frames.
 17. Install electrical outlets and similar junction boxes at indicated locations. Provide additional blocking and straps for proper locations; do not mount on "nearest" stud.
 18. Install steel studs so that flanges point in the same direction and so that leading edges or ends of each gypsum board can be attached to open (unsupported) edges of stud flanges first.
- E. Backer Plates:
1. Provide backer plate for securing surface mounted fittings, fixtures, accessories, and furnishings, including, but not limited to handrails, grab bars, toilet walls, towel bars, wall mounted door stops, and similar screw- and bolt-fastened items.
 2. Secure with sufficient quantity of self-tapping sheet metal screws to sustain loads imposed by items attached to backer plates.
- F. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- G. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
1. Where walls terminate at ceiling plane, extend vertical door jamb studs through suspended ceiling and attach to underside of structure above.

- H. Isolate non-load-bearing partitions located on slabs on grade at intersection with exterior walls and fixed structural abutments. Isolate partition studs from exterior wall or structural abutment framing to allow differential vertical movement.
 - 1. At window sill locations, extend isolated stud joint vertically and in alignment with joint below, to full height of partition.
- I. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
 - 1. Orientation: Vertical.
 - 2. Spacing: As permitted by standard.

3.05 INSTALLING RESILIENT CHANNELS

- A. Position resilient channels at right angles to wood framing, space 24 inches on center and attach to each support with 1-1/4 inch Type S screws driven through holes in channel mounting flange.
- B. Walls:
 - 1. Install channels with mounting flange down.
 - 2. Channel may be inverted at floor to accommodate attachment of base.
 - 3. Locate channels 2 inches (50.8 mm) from floor and within 6 inches (150 mm) of ceiling.
 - 4. Extend channels into corners and attach to corner framing.
 - 5. Position channels 6 inches (150 mm) maximum from wall-ceiling angle.
 - 6. Cantilever channel ends no more than 6 inches (150 mm).
 - 7. Double-Layer System: Attach channel through base layer to framing with 1-5/8 inch (41.27 mm) Type S screws. Splice channel by nesting directly over framing member, screw-attach through both flanges. Reinforce with 3/8 inch (9.53 mm) pan head screws located at both ends of splice.
- C. Resilient Channel Installation at Cabinets: Attach channels to studs at center of top and bottom cabinet hanger brackets. When distance between hangers exceeds 24 inches (610 mm) on center, install additional channel at mid-point between hangers.
 - 1. Place screws attaching cabinets to resilient channels between studs.
- D. Ceilings and Soffits: Apply resilient channels at 16 inches (406.40 mm) on center perpendicular to joists and fastened with 1-5/8 inch (41.27 mm) Type S screws in accordance with Section

3.06 DIRECT HUNG CEILING SUSPENSION SYSTEM INSTALLATION

- A. Attach perimeter wall track or angle where support system meets vertical surfaces.
- B. Space main runners at 48 inches (1200 mm) on center and cross tees at 24 inch (600 mm) on center, except as otherwise indicated.
- C. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- D. Hangers: 48 inches (1219.20 mm) o.c.
- E. Carrying Channels (Main Runners): 48 inch (1219.20 mm) o.c.
- F. Furring Channels (Furring Members): 16 inches (406.40 mm) o.c.
- G. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- H. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
7. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
8. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
9. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
10. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.07 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Insulation: Install in accordance with Section 09 8100 - Acoustic Insulation.
- C. Acoustical Sealant: Install in accordance with Section 079219 - Acoustical Joint Sealants.

3.08 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
 1. Space fasteners in accordance with ASTM C840 and manufacturer's recommendations, unless fastener spacing is otherwise specified on structural Drawings for structural load-bearing walls.
 2. Install interior wall and partition boards horizontally, except where fire or sound rating requires a particular direction; comply with the method stated in the tested assembly data.
 3. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches (600 mm) in alternate courses of board.
- B. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- C. Single-Layer Non-Rated Applications: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
 2. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 3. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 4. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 5. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

- D. Double-Layer Non-Rated Applications: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second and third layer from joints of first layer.
 - 1. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- E. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
 - 1. Limit annular space between gypsum wall board edges and electrical device boxes to maximum 1/8 inch (3 mm), or as limited by applicable Code.
- F. Cementitious Backing Board Applications: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
 - 1. Use cementitious tile backer board for wall surfaces in shower and tub areas, high water or humidity exposure areas, and other locations indicated for use behind thin-set tile.
 - 2. Install board with long edge perpendicular or parallel to framing. Hold bottom edge 1/4 inch above floor or fixture lip.
 - 3. Maintain manufacturer's required space between board edges.
- G. Installation on Metal Framing: Use screws for attachment of all gypsum board, except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- H. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch (6.35 mm) to 3/8 inch (9.53 mm) wide joints to install sealant.
- I. Isolate perimeter of non-load-bearing wallboard partitions on slabs on grade at intersection with exterior walls and fixed structural abutments. Provide 1/4 inch (6 mm) space to allow differential vertical movement and trim edges with L-type edge trim. Seal joints with acoustical sealant.
 - 1. At window sill locations, extend gypsum board joint vertically and in alignment with joint below, to full height of partition.
- J. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum board with floating internal corner construction, unless isolation of the intersecting boards is indicated, or unless control or expansion joints are indicated.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- L. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- M. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

3.09 SOUND ASSEMBLIES

- A. Resilient Channels:
 1. Space at a maximum of 16 inches (406.40 mm) on center.
 2. Locate joints over framing members.
- B. Gypsum Board:
 1. Fasten gypsum board to resilient channels between framing members supporting resilient channels.
 2. Do not use fasteners whose length is longer than depth of resilient channels.
 3. Install gypsum board vertically.
- C. Acoustical Insulation:
 1. Install acoustical insulation in walls where indicated.
 2. Place insulation for full distance of space between studs for full coverage of sound-rated assembly.
 3. Fit insulation tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind walls and tight to items passing through walls.
- D. Acoustical Sealant: Install in accordance with Section 079219 - Acoustical Joint Sealants.
- E. Acoustical Outlet Box Pads: Install in accordance with Section 079219 - Acoustical Joint Sealants.
- F. Intersections with Non-Sound-Rated Assemblies:
 1. Extend sound-rated construction to completely close sound flanking paths through non-sound-rated construction.
 2. Install acoustical sealant for exposed locations at joints between face layers at vertical interior angles of intersecting assemblies.

3.10 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at as indicated on Drawings.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.11 INSTALLATION OF TRIM AND ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Place control joints consistent with lines of building spaces as indicated on Drawings; if not specifically indicated, provide control joints as follows:
 1. Spacing: In accordance with GA 234.
 2. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
 3. At exterior soffits, not more than 30 feet (10 meters) apart in both directions.
 4. Do not bridge building control and expansion joints with gypsum board.. Utilize details shown in referenced standard.
 5. Terminate gypsum board on each side of joints.
 6. Extend control joints from both corners of door frames to top of wall where doors occur in long runs of wall.
 7. Comply with manufacturer requirements for constructing control and expansion joints in fire-rated assemblies.
 - a. Locate studs on both sides of joints. Attach two layers of gypsum board strips to back of one stud to fill area behind joint; provide continuous fire barrier behind joint without restricting movement.
 8. Locate in ceilings with area exceeding 900 square feet, where framing or furring changes direction, and spaced apart not more than 30 feet (10 m).
 9. Locate in ceilings where wings of "L", "U", and "T" shaped areas are joined.

- 10. Provide mineral fiber acoustical insulation or gypsum panel backing at control joints in fire-rated assemblies to maintain fire rating.
- C. Corner Beads: Install at external corners, using longest practical lengths.
 - 1. Attach with screws.
- D. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- E. Fasteners:
 - 1. Attachment Methods:
 - a. Attach board to framing and furring with screws.
 - b. Attach board to board with screws.
 - 2. Except where indicated otherwise or where required for fire rated assemblies, space fasteners in compliance with more restrictive requirements of referenced installation standards or manufacturer's requirements.
 - 3. Attach board to supplementary framing and blocking which provide additional support at openings and cutouts

3.12 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5:
 - a. Locations indicated on Drawings.
 - b. Vinyl graphics and other specialty areas.
 - c. Use at areas of severe lighting.
 - d. Embed joints and interior angles in joint compound. Apply 3 coats joint compound over joints, angles, fastener heads, and accessories.
 - e. Joint Compound: Smooth and free of tool marks and ridges.
 - f. Skim Coat: High build gypsum board surfacer.
 - 2. Level 4:
 - a. Walls and ceilings to receive paint finish or wall coverings other than as indicated on Drawings.
 - b. Walls to receive FRP panels.
 - c. Embed joints and interior angles in joint compound. Apply 3 coats joint compound over joints, angles, fastener heads, and accessories.
 - d. Joint Compound: Smooth and free of tool marks and ridges.
 - e. Surface to be coated texture as indicated.
 - 3. Level 3:
 - a. Areas to receive glass-fiber faced tile backing gypsum board used as a tile substrate.
 - b. Use at locations such as storage, service rooms, riser closets, electrical rooms, and equipment rooms.
 - c. Embed joints and interior angles in joint compound. Apply 2 coats joint compound over joints, angles, fastener heads, and accessories.
 - d. Joint Compound: Smooth and free of tool marks and ridges.
 - e. Surface to be coated texture as indicated.
 - 4. Level 2:
 - a. Fire-rated, sound-rated, and smoke-rated assemblies in ceiling plenums and concealed areas.
 - b. Use at concealed areas and construction not indicated to be Levels 3, 4, or 5.
 - c. Embed joints and interior angles in joint compound. Apply one coat joint compound over joints, angles, fastener heads, and accessories.
 - d. Surface: Free of excess joint compound.
 - 5. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.

- a. Embed joints and interior angles in joint compound. Apply 2 coats joint compound over joints, angles, fastener heads, and accessories.
 - b. Surface: Free of excess joint compound.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
- 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
 - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.
- D. High Build Gypsum Board Surfer: Where approved by Architect, at locations indicated to receive Level 5 finish spray apply high build drywall surfer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.13 ADJUSTING

- A. Adjust and align metal framing to properly receive final finishes in accordance with required tolerances.
- B. Correct damages, defects, and leave work ready for decoration. Clean compounds from trim. Visible cracks, nail heads, tool marks, waves, distortions, or other similar defects shall not appear in finished work.

3.14 CLEANING

- A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.
- B. Promptly remove joint compound from surfaces not intended to receive compound.

3.15 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.16 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

SECTION 09 2236.23

METAL LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal lath for cement plaster.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.
 2. Shop drawings: show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work. Include details for all plaster accessories depicting integration with adjacent membranes and finishes
 3. Samples: Metal Trim
- B. Informational Submittals:
 1. Installer Qualifications
 2. Material Certificates
 3. Sample Warranty

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 2. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 3. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.04 QUALITY ASSURANCE

- A. Maintain one copy of each specified installation standard on site throughout the duration of lathing and plastering work.
- B. Installer Qualifications: Company specializing in performing the work of this Section a minimum three years documented experience.
 1. Experience: Company with not less than 10 years experience in performing specified Work similar to scope of this Project, and with a record of successful in-service performance, and sufficient production capability, facilities and personnel, to produce required Work.
 2. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product:
 1. Structa Wire Corporation; Structa Mega Lath: www.structawire.com.
 2. Approved equal.
 3. Other Acceptable Manufacturers:

- a. Alabama Metal Industries Corporation www.amico-lath.com.
- b. CEMCO; California Expanded Metal Products Co.
- c. ClarkDietrich Building Systems.

2.02 LATH ASSEMBLIES

- A. Provide completed assemblies with the following characteristics:
 1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs (445 N).
 2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.

2.03 LATH MATERIALS

- A. Welded Wire Lath: ASTM C933; 17 gage galvanized by 16 gage; with 0.7 inch (17.8 mm) 1-1/2 inch (38 mm) openings, of weight to suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.
 1. Applications: Use at vertical wall surfaces.
 2. Basis of Design Manufacturer:
 - a. Structa Wire Corp.; Structa Mega Lath.
- B. Corner Mesh: ASTM C1063; Formed sheet steel, minimum 0.018 inch (0.5 mm) thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch (50 mm) size; same finish as lath.
- C. Strip Mesh: Expanded metal lath, same weight as lath, 2 inch (50 mm) wide by 24 inch (600 mm) long; same finish as lath.
- D. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
 1. Material: Formed G90/Z275 galvanized sheet steel, expanded metal flanges.
 2. Casing Beads with Weep Holes: Square edges.
 - a. Basis of Design Product:
 - 1) Clark Western; No. 66X Expanded Flange Casing Bead.
 3. Corner Beads: Square corners.
 - a. Basis of Design Product:
 - 1) Clark Western; No. 1A Expanded Corner Bead.
 4. Sill (Weep) Screeds: Bevelled edges; minimum 3-1/2 inch vertical attachment flange.
 - a. Basis of Design Product:
 - 1) Clark Western; No. 36 Foundation Sill Screed.
 5. Head Drip Screeds: Bevelled edges; minimum 3-1/2 inch vertical attachment flange, 45-degree slope allows for water to weep out of the assembly, and 90-degree return provides a 3/4-inch solid metal leg.
 - a. Basis of Design Product:
 - 1) CEMCO; No. 6.
 6. Flashing Screeds: 3-1/2 inch vertical attachment flange, single-piece 45-degree weep screed, for drainage, and a Z flashing for window head protection
 - a. Basis of Design Product:
 - 1) CEMCO; No. 3.
 7. Base (Weep) Screeds: Square edges; minimum 3-1/2 inch vertical attachment flange.
 - a. Basis of Design Product:
 - 1) Clark Western; 3-1/2" J-Weep High Back.
 8. Horizontal Control Joints: Accordion profile with factory-installed protective tape, 2 inch (50 mm) flanges.
 - a. Basis of Design Product:
 - 1) Clark Western; No. 15 and No. 30 (corner) Control Joint.
 - 2) CEMCO; Double "V" Control Joint (#15).

9. Vertical Control Joints: Two-piece, slip joint that finishes butt ends of adjacent panels, 1 inch (25 mm) flanges.
 - a. Joint Width: As indicated on Drawings
 - b. Basis of Design Product:
 - 1) Clark Western; #40 Zinc Two-Piece Expansion Joint.
 - 2) CEMCO; XJ15.
10. Expansion Joints: Two-piece, slip joint that finishes butt ends of adjacent panels, 3 inch (76.2 mm) flanges.
 - a. Joint Width: As indicated on Drawings
 - b. Basis of Design Product:
 - 1) Clark Western; #40 Zinc Two-Piece Expansion Joint.
 - 2) CEMCO; XJ15.
11. Reveal Drip Screeds:
 - a. Material: Aluminum.
 - b. Finish: Factory primed.
 - c. Provide flanges for embedding into plaster system.
 - d. Sizes and locations as indicated on Drawings.
 - e. Provide ventilating type for venting space above soffit.
 - f. Basis of Design Product:
 - 1) Fry Reglet Corporation; DS-875-875.
12. Continuous Insulation Furring Strips: 18 GA Galvanized Steel G60 "L" shaped.
 - a. Basis of Design Product:
 - 1) Brand X Metals, Inc.; Diamond Furr C.I. Lath Attachment System DF-2375: www.brandxmetals.com.

2.04 ACCESSORIES

- A. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
- B. Fasteners: ASTM C1002 self-piercing tapping screws; length required to penetrate minimum 3/4 inch into framing or solid backing, or as required by ASTM C1063, whichever is greater length.
- C. Weather Barrier: Specified in Section 07 2500 - Weather Barriers.
- D. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

- A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.
- B. Install lath for Portland cement plaster in accordance with ASTM C1063.
 1. Fastener Spacing: Space fasteners 6 inch on center vertically, or as otherwise required by reference standard requirements.
- C. Install lath and furring for fire-rated assemblies in accordance with requirements of assembly as indicated.

3.03 CONTROL JOINTS

- A. Locate joints as indicated on drawings and comply with ASTM C1063.
 - 1. Area of plaster panel not to exceed 144 sq ft (13.4 sq m) for vertical surfaces.
 - 2. Area of plaster panel not to exceed 100 sq ft (9.3 sq m) for horizontal, curved or angled surfaces.
 - 3. Spacing between control joints not to exceed 18 ft (5.5 m) in each direction.
 - 4. Area bounded by control joints not to exceed a length-to-width ratio of 2-1/2 to 1.
- B. Install expansion joints where an expansion joint occurs in base exterior wall.
- C. Install prefabricated joint accessories in accordance with ASTM C1063.
- D. Installing Accessories:
 - 1. Place corner aid at external wall corners; fasten at outer edges of lath only. Wire-tie outside corner - aid to wall lath with wire-toes at 9 in. on center.
 - 2. Embed ends of control joints and expansion joints at ends and intersections with sealant, refer to Section 07 9200 - Joint Sealants.
 - 3. Place casing beads, soffit screeds, window head screed, and foundation sill screeds at terminations of plaster finish, as shown on drawings.
 - a. Butt and align ends.
 - b. Set level.
 - c. Secure rigidly in place.
 - 4. Weather lap trim pieces, unless detailed otherwise
- E. Locate joints as indicated on Drawings.
 - 1. Control Joint Spacing: Maximum 12 feet (4 m) on center.
 - 2. Expansion Joint Spacing: Maximum 30 feet (10 m) on center.
- F. Install control and expansion joints using specified accessories, where indicated.
 - 1. Provide discontinuous lath on either side of control joint and securely fasten lath to solid blocking or framing
 - 2. Cut primary lath continuously along centerline of expansion joints.
 - 3. Wire-tie expanded flanges of accessories to primary lath; screw fasteners not permitted for this purpose.
 - 4. Continue vertical control joints beyond horizontal control joints at intersections

3.04 TRIM ACCESSORY INSTALLATION

- A. Install trim accessories, i.e. weep screeds, casing beads, reveals, drip molds, corner reinforcement and control/expansion joints plumb, level and straight. Intersections and terminations shall be neatly mitered and align with adjoining trims. Set grounds to provide specified plaster thickness.
- B. Install longest length possible. Do not to use pieces shorter than 72 inches (1829 mm) in length.(i.e. a 12'-0" (3658 mm) opening shall have two 72 inch (1829 mm)) pieces.
- C. Attach trim accessories to remain firm and solid during plastering. Attachment should not exceed 24 inches (610 mm) on center.

3.05 LATH INSTALLATION

- A. Apply lath taut, with long dimension perpendicular to supports.
- B. Lap ends of non-metallic lath in accordance with ASTM C1787.
- C. Attach metal lath to concrete using wire loops. Attach anchors to backup surface; space at maximum 24 inches (600 mm) on center.
- D. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches (75 mm) from corner to form the angle reinforcement; fasten at perimeter edges only.

- E. Place corner bead at external wall corners; fasten at outer edges of lath only with wire ties.
- F. Place base screeds at termination of plaster areas; secure rigidly in place.
- G. Place 4 inch (100 mm) wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place. Provide expansion joint at junctions of dissimilar framing materials
- H. Place lath vertically above each top corner and each side of door frames to 6 inches (150 mm) above ceiling line.
- I. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- J. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

3.06 TOLERANCES

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from True Position: 1/8 inch (3 mm).

END OF SECTION

**SECTION 09 2400
CEMENT PLASTERING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cement plastering.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate components of fire rated assemblies with materials specified for support of plaster in other Sections.
- B. Preinstallation Conference: Conduct conference at Project site.
 - 1. Prior to application of Cement Plaster Work, Contractor, Installer, and other Installers whose work may affect quality of work shall meet at the Project site to coordinate related requirements and plaster work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide data on plaster materials and trim accessories.
 - 2. Shop drawings: Coordinate with Section 09 2236.23 - Metal Lath.
 - 3. Samples:
 - a. Submit 3 samples, 12 by 12 inch (300 by 300 mm) in size illustrating finish color and texture.
 - b. Submit two samples of each type trim accessory.
- B. Informational Submittals:
 - 1. Evaluation Service Reports: Show compliance with specified requirements.
 - 2. Installer Qualifications: Written data for company, principal, personnel, experience, and training required by "Quality Assurance" article.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 2. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 3. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 MOCK-UP

- A. Construct mock-up of exterior wall, 10 feet (3 m) long by 10 feet (3 m) wide, illustrating surface finish.
 - 1. Locate where directed.

2. Approval of mockups does not constitute approval of deviations from contract document contained in mockup unless Architect specifically approves changes if requested by Architect, make modifications to mockups or provide additional mockups without charge to Owner. Do not proceed with remainder of installation until mockups have been accepted by Architect and Owner
3. Construct over backing using same materials and system as specified and to be used on building under underlayment, lath, base coat, and finish coat. Include 1/2 inch (12.70 mm) channel screed in both horizontal and vertical direction with intersection
4. Mock-up may remain as part of this work.

1.07 FIELD CONDITIONS

- A. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F (4 degrees C) or lower, or when temperature is expected to drop below 40 degrees F (4 degrees C) within 48 hours of application.
- B. Do not use frozen or previously frozen materials; do not apply cement plaster to frozen surfaces or surfaces with frost present.
 1. Protect installation from freezing minimum 24 hours after initial set.
- C. Do not install cement plaster in direct sunlight for extended periods of time to prevent uneven or premature evaporation.

PART 2 PRODUCTS

2.01 CEMENT PLASTER APPLICATIONS

- A. Lath Plaster Base: Metal lath.
 1. Plaster Type: Factory prepared plaster mix.
 2. Number of Coats: Three, textured as indicated on Drawings.
 - a. First Coat: Apply to a nominal thickness of 3/8 inch (9 mm).
 - b. Second Coat: Apply to a nominal thickness of 3/8 inch (9 mm).
 - c. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch (0.79 to 1.6 mm).
 - d. Texture: Fine Sand.

2.02 FACTORY PREPARED CEMENT PLASTER

- A. Premixed Plaster for Stucco Scratch and Brown Coats: Factory mixed and packaged, complying with material requirements of ASTM C926.
 1. Acceptable Products:
 - a. Amerimix, an Oldcastle brand; AMX 700 SBF: www.amerimix.com.
 - b. BMI Products; BMI 690 Standard with Fibers: www.bmi-products.com.
 - c. LaHabra Stucco Solutions; Fiber 47 Armour Wall Scratch & Brown Sanded: www.lahabrastucco.com.
 - d. Omega Products; Super Cement Fibered: www.omega-products.com.
- B. Premixed Textured Coating: Polymer modified acrylic coating, integrally colored, and trowel applied to substrates prepared in accordance with manufacturer's written installation instructions.
 1. Finish Texture: Fine sand.

2.03 ACCESSORIES

- A. Lath: As specified in Section 09 2236.23 - Metal Lath.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 09 2236.23 - Metal Lath.
- C. Sealant: As specified in Section 07 9200 - Joint Sealants.
- D. Fiber Reinforcement: Nylon or polypropylene monofilament fibers conforming to ASTM C 1116 Type III (synthetic fiber-reinforced concrete or shotcrete). AR chopped glass fiber strands are not permitted.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

2.04 PLASTER MIXES

- A. Over Metal Lath: Mixed and proportioned in accordance with ASTM C926.
 1. Three-coat application.
- B. Premixed Plaster Materials: Mix in accordance with manufacturer's instructions.
- C. Finish Coat: Premixed.
 1. Add color pigments to finish coat in accordance with manufacturer's instructions.
- D. Mix only as much plaster as can be used prior to initial set.
- E. Add color pigments to finish coat in accordance with manufacturer's instructions.
- F. Mix materials dry, to uniform color and consistency, before adding water.
- G. Protect mixtures from freezing, frost, contamination, and excessive evaporation.
- H. Do not retemper mixes after initial set has occurred.

2.05 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Sealant: As specified in Section 07 9200 - Joint Sealants.
- C. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify that weather barrier and air barrier are properly installed.
- C. Verify masonry joints are flush and surfaces are ready to receive work of this section, and that there are no existing bituminous or water repellent coatings on masonry surfaces.
- D. Verify metal lath has been installed in accordance with Section 09 2236.23 - Metal Lath.
 1. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.
- E. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

3.02 PREPARATION

- A. Protect finished surfaces installed prior to plastering as required to prevent damage. Maintain protection in place until completion of plastering
- B. Dampen masonry surfaces to reduce excessive suction.
- C. Apply dash bond coat of plaster to solid bases and moist cure for at least 24 hours before applying first coat of jobsite mixed plaster.

3.03 MIXING

- A. Mix only as much plaster as can be used prior to initial set.

- B. Mix materials dry, to uniform color and consistency, before adding water.
- C. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.04 APPLICATION

- A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.
- B. Base Coats - General:
 - 1. Apply base coats to fully embed lath and to specified thickness.
 - 2. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.
 - 3. Do not deviate more than plus or minus 1/4 inch (6.35 mm) in 10 feet (3 m) from a true plane in finished plaster surfaces when measured by a 10 foot (3 m) straightedge placed on surface.
 - a. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - b. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- C. Three-Coat Application Over Metal Lath:
 - 1. Apply first coat to a nominal thickness of 3/8 inch (9 mm).
 - 2. Apply second coat to a nominal thickness of 3/8 inch (9 mm).
 - 3. Apply reinforcing mesh in leveling coat while still wet; smooth mesh and remove wrinkles and loose ends.
 - 4. Apply leveling coat.
 - 5. Apply finish coat to a nominal thickness of 1/8 inch (3 mm).
- D. Application of Scratch Coat:
 - 1. Apply to uniform thickness indicated to completely embed metal lath.
 - 2. Uniformly score surface approximately 3/8 inch (9.53 mm) deep.
 - 3. Allow to cure 7 days before applying brown coat.
- E. Application of Brown Coat:
 - 1. After scratch coat has cured to be sufficient rigid, apply brown coat to uniform thickness indicated over damp scratch coat with sufficient material and pressure to ensure tight, uniform bond.
 - 2. Rod to true, even plane, filling surface defects with plaster.
 - 3. Uniformly float surface 3/8 inch (9.53 mm) deep.
 - 4. Allow to cure 7 days before applying brown coat.
- F. Finish Coats:
 - 1. Primer and Cementitious Coatings: Machine applied.
 - a. Remove surface contaminants such as dust and dirt without damaging substrate.
 - b. Apply primer in accordance with manufacturer's instructions.
 - c. Apply finish coating in number of coats and to thickness recommended by manufacturer.
- G. Moist Curing:
 - 1. Follow procedures for each coat as recommended by ASTM C926 and PCA and as required based on environmental conditions.
 - 2. Prevent premature dry-out.
 - a. Cure each coat minimum 48 hours;
 - 1) Allow minimum 7 day interval between application of scratch and brown coat.
 - 2) Allow minimum 7 day interval between application of brown and finish coat.
 - 3) Keep scratch and brown coat uniformly moist during curing period by applying fine fog spray of water. Apply fog spray at least twice daily in morning and evening. Exercise care to avoid eroding scratch coat.

- H. Cementitious Finishes: After curing, dampen previous coat prior to applying finish coat.
- I. Acrylic Finishes:
 - 1. Dampen previous coat only if required or recommended by finish coat manufacturer.
 - 2. Air cure only; do not wet cure as recommended by finish coat manufacturer.

3.05 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet (6 mm in 3 m).

3.06 REPAIR

- A. Cut, patch, repair and point-up cement plaster as necessary to accommodate other work. Point-up finish plaster surfaces around items that are built into or penetrate plaster surfaces.
- B. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

3.07 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 09 3000**TILING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. River rock.
- E. Crack isolation membranes.
- F. Waterproofing membranes.
- G. Self-leveling underlayment over tiling substrates.
- H. Stone thresholds.
- I. Non-ceramic trim.

1.02 DEFINITIONS

- A. Module Size: Actual tile size, with minor facial dimension as measured by ASTM C499, plus joint width indicated.
- B. Facial Dimension: Actual tile size, with minor facial dimension as measured by ASTM C499.
- C. Large Format Tile: Any tile unit that maintains an edge of 15 inches or greater in any dimension.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate location of tiling movement joints on concrete floor substrates with locations of concrete floor expansion and control joints; align substrate joints and tiling system joints where required by specified reference standards.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this Section; require attendance by all affected installers.
 - 1. Review installation procedures and coordination requirements.
 - 2. Meeting Agenda includes but is not Limited to:
 - a. Acceptance of substrate.
 - b. Surface preparation.
 - c. Tile and installation material compatibility.
 - d. Elastomeric membrane.
 - e. Crack isolation techniques.
 - f. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide manufacturer's data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
 - 2. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
 - 3. Samples: Submit three 4 inch (101.6 mm) by 4 inch (101.6 mm) samples of each tile type, noting actual tile size.

- a. Include samples of specified accessories per Finish Schedule.
- b. Submit three samples of each grout color per Finish Schedule.
- 4. Samples: Submit manufacturer's color boards consisting of actual tiles showing full range of colors, textures, and patterns available for each type and composition of tile specified.
 - a. Include samples of specified accessories requiring color selection.
 - b. Submit manufacturer's color samples of available grout consisting of actual sections of grout showing full range of colors available for each type of grout specified.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 2. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
 - 3. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- C. Closeout Submittals:
 - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than 10 square feet of each type.

1.05 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this Section, with minimum 5 years of documented experience.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 - a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
- D. Provide materials obtained from only one manufacturer for each type and color of tile, and for each type of mortar, grout, adhesive, and sealant.
- E. Floor Tile Slip Resistance: Comply with ANSI A137.1, Dynamic Coefficient of Friction AcuTest of 0.42 wet as tested with BOT-3000 Universal Walkway Tester.
- F. Certifications:
 - 1. Submit "Master Grade Certificate" for each type of ceramic and quarry tile in accordance with requirements of ANSI A137.1.
 - 2. Submit manufacturer's certifications that mortars, adhesives and grouts are suitable for intended use.

1.07 MOCK-UP

- A. Refer to Section 01 4339 - Mockups and Field Samples, for general requirements for mock-up.
- B. Mock-up: Construct tile mock-up as directed by Architect, incorporating all components specified for the location.
 - 1. Architect to review tile layout prior to installation.

2. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Comply with referenced standards and manufacturer's recommendations for protection and maintenance of environmental conditions during and after installation.
- B. Do not install solvent-based products in an unventilated environment.
- C. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation, and for at least seven days after installation. Maintain higher temperatures for proprietary mortars and grouts when recommended by manufacturer.
- D. Vent temporary heaters to the exterior to prevent damage to tile work due to carbon dioxide accumulation.

PART 2 PRODUCTS

2.01 TILING MATERIALS

- A. Refer to Finish Schedule for selected products and finishes.
- B. Ceramic tile flooring shall be stable, firm, and slip resistant.

2.02 STONE TILE MATERIALS

- A. Refer to Finish Schedule for selected products and finishes.
- B. River Rock: White, smooth rocks, 3/4 inch (19.05 mm) to 1-1/2 inch (38 mm) diameter.

2.03 TRIM AND ACCESSORIES

- A. Trim Shapes:
 1. Base, caps, returns and other trim accessories as required; same characteristics as tile.
 2. If base is cut from full-size tile, bevel top edge and polish to match face.
- B. Metal Trim: Style, configuration, and dimensions as indicated on Finish Schedule, for setting using tile mortar or adhesive.
 1. Finish: Satin natural anodized extruded aluminum, style, configuration, and dimensions as indicated on drawings, for setting using tile mortar or adhesive.
 2. Applications: As indicated on Drawings
- C. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
 1. Thickness: 1/2 inch (12.7 mm).
 2. Material: Marble, honed finish.
 3. Color and Pattern: As indicated on drawings.
 4. Applications:
 - a. At doorways where tile terminates.
- D. Adhesives and sealants shall comply with VOC and chemical component limits of SCAQMD 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.

- E. Primers: As recommended by manufacturer of mortar, grout, crack isolation, and sealant materials.
 - 1. Use primers that comply with VOC limits of the current requirements of SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.

2.04 SETTING MATERIALS

- A. Setting Material - General:
 - 1. Comply with volatile organic compound (VOC) product requirements specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green.
 - 2. Use only the types of mortar bed materials to set the types of tile for which the mortar is labeled.
- B. Polymer Modified Thinset Dryset Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.
 - 1. Applications: Use this type of bond coat where indicated .
 - a. Acceptable Products:
 - 1) Custom Building Products; MegaFlex Crack Prevention Mortar: www.custombuildingproducts.com.
 - 2) LATICRETE International, Inc.; Laticrete 253 Gold: www.laticrete.com.
 - 3) Mapei Corporation; Kerabond and Keralastic.
 - 4) Prior approved equal.
- C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.
 - 1. Applications: Use this type of bond coat where indicated .
 - 2. Large and Heavy Tile Mortar: For floor and wall applications in new construction, provide high-bond Portland cement mortar for large format tile, medium bed. Provide product that is approved by manufacturer for application thickness up to 3/4 inch (19 mm).
 - a. Basis of Design Product:
 - 1) Custom Building Products; MegaLite RS Ultimate Rapid Setting Crack Prevention Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com.
 - 2) LATICRETE International, Inc.; LATICRETE 254 Platinum: www.laticrete.com.
 - 3) Mapei Corporation; Grani/Rapid with Ker 318.
 - 4) Prior approved equal.
 - 3. Applications: For wall applications, provide non-sagging, latex Portland cement mortar complying with ANSI A118.4 for mortar of this type.
 - a. For wall applications with large and heavy tile.
 - b. For floor applications with large and heavy tile.
- D. Portland Cement Mortar Thickset Installation Materials: ANSI A108.2.
 - 1. Acceptable Products:
 - a. Custom Building Products; Thick Bedding Mortar with CustomCrete Latex Mortar Admix.
 - b. Laticrete International, Inc.; Laticrete 3701 Mortar Admix with Laticrete 226 Thick Bed Mortar Mix.
 - c. MAPEI Corporation; Planicrete AC.
 - 2. Mortar Sand: ASTM C144, free of deleterious materials, well graded.
 - 3. Setting Bed Sand: ASTM C136/C136M, 100 percent passing No. 4 sieve.
 - 4. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils thick.
 - 5. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185/A 185M and ASTM A820/A820M, except for minimum wire size.
 - 6. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C847.
 - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
 - b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.

- c. Configuration over Studs and Furring: Flat.
- d. Configuration over Solid Surfaces: Self-furring.
- e. Weight: 2.5 lb/sq. yd..

2.05 GROUTS

- A. Stain-Resistant High Performance Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: as indicated on Drawings.
 - 2. Use sanded grout for joints 1/8 inch (3.17 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.17 mm) wide.
 - 3. Polymer Type: As recommended by manufacturer in liquid-latex form for addition to prepackaged dry-grout mix.
 - 4. Color(s): As indicated on Finish Schedule.
 - 5. Acceptable Products:
 - a. Custom Building Products; Fusion Pro Single Component Grout: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; Spectralock: www.laticrete.com.
 - c. Mapei Corporation; Ultracolor Plus.

- B. High Performance Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch (3.17 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.17 mm) wide.
 - 3. Polymer Type: As recommended by manufacturer in liquid-latex form for addition to prepackaged dry-grout mix.
 - 4. Color(s): As indicated on Finish Schedule.
 - 5. Acceptable Products:
 - a. Custom Building Products; Prism Ultimate Performance Grout: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout.
 - c. Mapei Corporation; Ultracolor Plus.
 - d. Prior approved equal.

2.06 ACCESSORY MATERIALS

- A. Adhesives and Sealants (including grouts): Only use adhesives and sealants (grouts) in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 on the interior of the building.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. SCAQMD 1168 referenced in Section 01 8114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
 - 3. Interior refers to all building construction that is inside of the exterior weatherproofing material.
 - a. Adhesives: Meet or exceed the VOC and chemical component limits of CAL-Green Table 5.504.4.1 Adhesive VOC Limit requirements.
 - b. Sealants: Meet or exceed the VOC and chemical component limits of CAL-Green Table 5.504.4.2 Sealant VOC Limit requirements.

- B. Sealant: As specified in Section 07 9200 - Joint Sealants.
 - 1. Color: Match grout.
 - 2. Ensure sealant is chemically compatible with tile, mortar, and grout.
 - 3. Ensure sealant can physically and chemically withstand environmental conditions normally expected at installation areas.

- C. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Crack Prevention Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
 - c. Basis of Design Product:
 - 1) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com.
 - 2) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com.
 - 3) Mapei Corporation; Mapelastic AquaDefense.
 - 4) Prior approved equal.
- F. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
 - c. Acceptable Products:
 - 1) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com.
 - 2) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com.
 - 3) Mapei Corporation; Mapelastic AquaDefense.
- G. Self-leveling Underlayment: Flowable, pre-formulated, water-mixed latex-Portland cement-based material; self-leveling to provide flat, level surface on tiling substrates.
 - 1. Acceptable Manufacturers:
 - a. Custom Building Products; "LevelQuick RS" Self Leveling Underlayment: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc.; 86 Latilevel Thin Pour: www.laticrete.com.
 - c. Mapei Corporation; Ultraplan 1 Plus: www.mapei.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- H. Backing Board: Specified in Section 09 2116 - Gypsum Board Assemblies.

2.07 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for tile flooring installation by testing for moisture and pH.
 - 1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
- E. Verify that required floor-mounted utilities are in correct location.
- F. Do not begin installation until substrates are acceptable for installation. Beginning installation means that the substrate is acceptable.

3.02 PREPARATION

- A. Protect surrounding work from damage.
 - 1. Vacuum clean surfaces and damp clean.
 - 2. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
 - 3. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch (6.35 mm) per 12 inches (305 mm) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Install crack isolation membrane to comply with ANSI A118.10 and membrane manufacturer's written instructions for full floor coverage.

3.03 WATERPROOFING AND CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install membrane to comply with ANSI A108.10 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- C. Flash membrane up adjacent walls and restraining surfaces. Make shower pans watertight, including connection to drain.
- D. Apply waterproofing on wall surfaces in shower areas covered by tile.
- E. Allow membrane to cure prior to setting tile.
- F. Do not allow construction traffic on membrane.

3.04 INSTALLATION - GENERAL

- A. Architect to review tile layout prior to installation.
- B. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation

methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 100 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 inches (203.20 mm) by 8 inch (203.20 mm) or larger.
 2. Tolerances:
 - a. Lippage: Set top of tiles flush with each other. Exposed face offset between adjacent tiles (lippage); 3/64 inch (1.19 mm) maximum.
 - b. Joint Width: 1/8 inch (3.17 mm), +/- 1/32 inch (0.79 mm), unless noted otherwise.
- C. Blending: For tile exhibiting color or pattern variations within the ranges of accepted submittals, verify that tile has been blended in the packages so that tile units taken from one package show same range in colors or patterns as those taken from other packages. If not blended in the packages, blend tile in the field before installation.
1. Floor System Coverage: Where specified for individual setting methods, install floor tile units with 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile units in referenced ANSI A108 specifications.
 2. Wall System Coverage: Where specified for individual setting methods, install wall tile units with 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile units in referenced ANSI A108 specifications.
 3. Movement Joints: Comply with TCNA EJ171 requirements for locations, spacing, and installation of applicable movement joints, whether or not specifically indicated or detailed on Drawings, and as follows:
 - a. Spacing - Interior: Maximum 24 feet on center in each direction; reduce spacing to maximum 10 feet on center in areas exposed to direct sunlight or moisture.
 - b. Joint Width: Match adjacent grouted joint widths, unless TCNA EJ171 requires a specific joint width based on joint location or joint service conditions.
 - c. Apply sealant joint to junction of tile and dissimilar materials and junction of dissimilar planes, including but not limited to floor to wall joints, corners, and metal trim and non-ceramic accessory items.
 - d. Keep movement joints free of setting adhesive and grout.
 - e. Form internal angles and corners square, not grouted, with sealant joint.
 - f. Form external angles and corners square, not grouted, with sealant joint.
 - g. Apply specified sealant to joints.
- D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- E. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- F. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- G. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- H. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- I. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- J. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Porcelain Mosaic Tile: 1/16 inch (1.58 mm), or less.
 2. Ceramic Mosaic Tile: 1/16 inch.
 3. Glazed Wall Tile: 1/16 inch.
 4. Porcelain Tile: 1/8 inch.
- K. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- L. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 1. Do not extend crack isolation membrane under thresholds set in dry-set portland cement mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane with elastomeric sealant.
- M. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- N. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- O. Install non-ceramic trim in accordance with manufacturer's instructions.
- P. Install thresholds where indicated.
- Q. Sound tile after setting. Replace hollow sounding units.
- R. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- S. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- T. Grout tile joints, except where movement joints are indicated or specified. Use standard grout unless otherwise indicated.
- U. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- V. Allow completed tiling assemblies to cure full 72 hours before allowing heavy foot or equipment traffic on final installations.

3.05 THIN-SET METHOD

- A. Apply mortar with notched trowel using scraping motion to work material into good contact with surface to be covered.
- B. Apply only as much mortar as can be covered within 20 to 30 minutes or while surface is still tacky.
- C. Trowel small quantity of mortar onto back (back-butter) of each tile.
- D. Set tiles in place and rub or beat with small beating block.
- E. Beat or rap tile to ensure proper bond and also to level surface of tile.
- F. Align tile to show uniform joints and allow to set until firm.
- G. Clean excess mortar from surface of tile with wet cloth or sponge while mortar is fresh.

3.06 GROUTING AND POINTING

- A. After tile has set sufficiently, fill joints with grout until flush with surrounding tile.
- B. Point joints full and remove excess grout. Clean tile thoroughly.
- C. Install sealant in vertical wall joints at interior corners.
- D. Install tile with maximum 25 percent variation of specified grout joint width.

3.07 EXPANSION JOINTS

- A. Keep expansion joints free of mortar and grout.
- B. Provide expansion joints directly over changes in material, over control and expansion joints in substrate, at juncture of floors and walls, at other restraining surfaces such as curbs, columns, bases, and wall corners, and where recommended by TCNA EJ171 Expansion Joint requirements.
- C. Install sealant in expansion joints.
- D. Provide sealant material at items penetrating tile work, unless otherwise indicated.
- E. Provide sealants and related materials in accordance with cited ANSI and TCNA requirements.

3.08 ADJUSTING

- A. Sound tile after setting. Replace hollow sounding units.
- B. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

3.09 CLEANING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- B. Leave finished installation clean and free of cracked, chipped, broken, un-bonded, or otherwise defective tile work.

3.10 PROTECTION

- A. Protect installed tile work with masonite or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Do not permit traffic over finished floor surface for 7 days after installation.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.11 SCHEDULES

- A. Floor Tile Installation Schedule:
 - 1. Thin Bed Floor Tile System:
 - a. Description: Thin set with crack isolation membrane.

- b. Location: Toilet Rooms on ground floor.
 - c. Tile: Porcelain
 - d. Mortar: Polymer Modified Thinset Dryset Mortar.
 - e. Grout: Stain-resistant high performance grout sanded.
 - f. TCNA system: F-113.
2. Thin Bed Floor Tile System:
- a. Description: Thin set with waterproofing membrane.
 - b. Location: Toilet Rooms on upper floors.
 - c. Mortar: Polymer Modified Thinset Dryset Mortar.
 - d. Grout: Stain-resistant high performance grout sanded.
 - e. TCNA system: F-122 Full, except where partial coverage is indicated.
- B. Wall Tile Installation Schedule:
1. Interior Wall Tile System:
- a. Description: Interior partitions using cementitious tile backing board.
 - b. Location: Toilet Rooms.
 - c. Tile: Porcelain
 - d. Mortar: Polymer Modified Thinset Dryset Mortar.
 - e. Grout: Stain-resistant high performance grout sanded.
 - f. TCNA System: W244C.
- C. Shower Installations:
1. Tile Shower Receptor; thickset mortar on waterproof membrane on concrete slab
- a. Location: Showers.
 - b. Membrane: Fluid.
 - c. Mortar: Polymer Modified Thinset Dryset.
 - d. Grout: Stain-resistant high performance grout sanded.
 - e. TCNA system: B41.
2. Tile Shower Wall; thinset mortar on waterproof membrane over unbonded mortar bed.
- a. Location: Showers.
 - b. Description: Thickset with waterproofing membrane.
 - c. Cleavage membrane.
 - d. Mortar Bed: Portland Cement With Latex Additive; Thick-Set
 - e. Reinforcing: Metal lath.
 - f. Mortar: Polymer Modified Thinset Dryset Mortar.
 - g. Grout: Stain-resistant high performance grout sanded.
 - h. Membrane: Fluid.
 - i. TCNA system: B441.

END OF SECTION

**SECTION 09 5100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
 - 1. Do not install acoustical units until after interior wet work is dry.

1.03 SUBMITTALS

- A. Action Submittals
 - 1. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
 - 2. Product Data: Provide data on suspension system components and acoustical units.
 - 3. Samples: Submit three samples 4 by 4 inch (102 by 102 mm) in size illustrating material and finish of acoustical units.
- B. Informational Submittals
 - 1. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements for the following:
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Sealants.

1.05 QUALITY ASSURANCE

- A. System Installer Qualifications: Company specializing in the installation of products specified in this Section with minimum three years documented experience.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

1.06 MOCK-UP

- A. Mock-ups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Indicate portion of ceiling represented by mock-up on Drawings or draw mock-up as separate element.
 - 2. Build mock-up of typical ceiling area as shown on Drawings.
 - 3. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 5 percent of quantity installed, but not less than a full box.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 5 percent of quantity installed.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.09 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 20 to 40 percent prior to, during, and after acoustical unit installation.
- B. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Acoustical Panels: Manufacturer's defects in material
 - b. Grid System: Rusting and manufacturer's defects
- B. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance Requirements: Design and install systems to comply with code requirements for suspended acoustical ceilings in seismic zones. Include:
 - 1. Use Heavy Duty Grid.
 - 2. Minimum 3/4 inch (19 mm) clearance from grid end to wall.
 - 3. Minimum 2 inch (50 mm) perimeter molding.
 - 4. Grid must be attached on two adjacent walls, no attachment on other two walls.
 - 5. Perimeter T ends tied together at perimeters (Spacer/Stabilizer bar) on tees that are not attached to perimeter molding.
 - 6. Ceiling areas over 1,000 SF must have horizontal restraint wire or rigid bracing.
 - 7. Partition attachment bracing is required to be independent from ceiling splay bracing.
 - 8. Provided seismic separation joint at areas greater than 2500 sq. ft. or full height partitions.
 - 9. Provide rigid bracing at ceiling elevation changes.
 - 10. Interior Suspended Ceilings, Soffits, and Bulkheads: Maintain deflection of not more than L/360 of distance between supports.
 - 11. Perimeter support wires within 8 inches.

- B. Surface-Burning Characteristics: Comply with ASTM E 84, 2009 Edition; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.
- C. Fire-Resistance Ratings: Comply with ASTM E 119, 2007 Edition; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 ACOUSTICAL UNITS

- A. Refer to Finish Schedule for selected products and finishes.
- B. Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches (610 by 610 mm).
 - 3. Thickness: 1 inch (25 mm).
 - 4. Panel Edge: Tegular.
 - 5. Suspension System: Exposed grid.
 - 6. Basis of Design Product:
 - a. Armstrong World Industries, Inc; Calla: www.armstrongceilings.com.

2.03 SUSPENSION SYSTEMS

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with splices and perimeter moldings as required.
 - 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
 - 2. Comply with regionally-sourced, recycled content, and adhesives and sealants product requirements specified in Section 01 8113 - Sustainable Design Requirements - LEED.
 - 3. Comply with regionally-sourced, recycled content, and adhesives and sealants product requirements.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.
 - 1. Application(s): Seismic.
 - 2. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
 - 3. Profile: Tee; 15/16 inch (24 mm) face width.
 - a. Main Beam: 12 foot Heavy Duty No. 7301.
 - b. Cross Runner: 2' Cross Tee No. XL7328.
 - c. Siesmic Wall Clip: Berc-2.
 - 4. Finish: Baked enamel.
 - 5. Color: White.
 - 6. ICC-ES Evaluation Report: ESR-1308.
 - 7. Products:
 - a. Armstrong World Industries, Inc; PRELUDE XL 15/16" Exposed Tee: www.armstrongceilings.com.
- C. Grid Suspension System for Gypsum Board Ceilings: As specified in Section 09 2116 - Gypsum Board Assemblies.

2.04 ACCESSORIES

- A. Fasteners for Face Fastening: Sharp point screw, all in one self-stop fastener.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Cast-in-place or Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- D. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- E. Wire Hangers, Braces, and Ties: Provide wires as follows:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 12 gage, 0.106 inch (2.69-mm) diameter wire.
- F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- H. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- I. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Verify existing conditions before starting work.
- C. Verify that layout of hangers will not interfere with other work.
- D. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - GENERAL

- A. General: Install acoustical panel ceilings to comply with ASTM C636/C636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E580/E580M.
- C. CISCA Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies."

3.04 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this Section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size unless noted otherwise on Drawings.
- D. Locate system on room axis according to reflected plan.
- E. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- F. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- G. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- H. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch (19 mm) clearance between grid ends and wall.
- I. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- J. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
- K. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- L. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
- M. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

- N. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
 - 1. Support all fixtures weighing greater than 56 lb by at least two supplementary No. 12 gage, 0.109 inch (2.78 mm) hangers if required by applicable building code; hangers may be slack.
- O. Do not eccentrically load system or induce rotation of runners.
- P. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- Q. Space hangers not more than 48 inches (1219.20 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (203.20 mm) from ends of each member.
- R. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- S. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.

3.05 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units as indicated on Drawings, unless otherwise indicated or directed.
- D. Fit border trim neatly against abutting surfaces.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Do not support light fixtures, air terminals, or other devices from acoustical ceiling panels or ceiling grid. Provide independent support..

3.06 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Compliance of seismic design.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.

- b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.07 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.08 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

**SECTION 09 5426.11
LINEAR WOOD CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured linear wood ceiling system.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of ceiling system with size, location and installation of fire sprinkler system.
- B. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this Section; require attendance by all affected installers.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Discuss layout, installation procedures, and coordination with adjacent work.

1.03 SUBMITTALS

- A. Product Data: Provide data for ceiling materials and specified accessories.
- B. Shop Drawings: Indicate end joint pattern and termination details.
 - 1. Indicate provisions for expansion and contraction.
- C. Samples: Submit three samples 12 by 12 inch (305 by 305 mm) in size illustrating ceiling veneers, finish, color, and sheen.
- D. Installation Instructions: Indicate standard and special installation procedures.
- E. Maintenance Data: Include maintenance procedures.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of this Section with minimum three years experience.
- B. Installer Qualifications: Licensee of WI's Certified Compliance Program.
- C. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- D. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.
- E. Quality Certification: Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 1. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.

5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
6. Arrange and pay for inspections required for certification.
7. Replace, repair, or rework all work for which certification is refused.

F. Fabrication and Installation Standards: Fabricate and install in accordance with North American Architectural Woodwork Standards – 3.0 as listed below.

1. Lumber grades: Section 3.
2. Panel products: Section 4.
3. Standing and running trim: Section 6.
4. Wall Surfacing: Section 8.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWMAC/WI (NAAWS) .

1.06 FIELD CONDITIONS

- A. Do not install wood ceiling until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum relative humidity of between 25 percent and 55 percent.
- B. Provide heat, light, and ventilation prior to installation.
- C. Store materials in area of installation for minimum period of 48 hours prior to installation.
- D. Maintain minimum room temperature of between 50 degrees F (14 degrees C) and 85 degrees F (29 degrees C) for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

PART 2 PRODUCTS

2.01 CEILING SYSTEM

- A. Wood Slat Ceiling:
 1. Composition: Fire-retardant particleboard with face-cut veneers complying with ASTM E84; Flame Spread Index 25 or less, Smoke Developed Index 50 or less.
 2. Ceiling Classification: ASTM E1264; Composite, Fire Class A.
 3. Grille:
 - a. Veneer Species: As indicated on Finish Schedule.
 - b. Base Wood: Poplar.
 4. Thickness: 5/8 inch (15.87 mm).
 5. Depth: 2-1/2 inches.
 6. Blades per Foot: 6
 7. Panel Width: 12 inches (305 mm).
 8. Panel Length: 96 inches (2438.40 mm).
 9. Edges: Square.
 10. Edge Banding and Trim: To match face veneer
 11. Closure panels at sides.
 12. Flame Spread: ASTM E84 HPVA Fire Classification Class C
 13. Dimensional Stability: Standard
- B. Finish: Clear, matte sheen.
- C. Stain: Match Architect's sample.
- D. Attachment System:
 1. Manufacturer's standard clips.

2.02 SUSPENSION SYSTEMS

- A. Suspension Systems: As specified in Section 095100 - Acoustical Ceilings.

2.03 ACCESSORIES

- A. Clips: Manufacturer's standard panel mounting clips and fasteners.
- B. Perimeter Trim: Manufacturer's standard angle and shadow moldings to suit indicated applications.
- C. Acoustical Infill: Manufacturer's standard acoustical backing.
 - 1. Color: Black, with polybag.
- D. Fasteners: Manufacturer's standard self-tapping screws.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which wood suspended ceiling attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of wood suspended ceiling.
- B. Verify existing conditions before starting work.
- C. Verify that required above-ceiling systems and components are in correct locations.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of wood panels to balance border widths at opposite edges of each ceiling. Comply with layout shown on reflected ceiling plans. Avoid use of less than half width units at borders. Coordinate panel layout with mechanical and electrical fixtures.

3.03 INSTALLATION - GENERAL

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E580.
- C. CISCA Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies."

3.04 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in Section 095100 - Acoustical Ceilings.

3.05 INSTALLATION - LINEAR WOOD CEILINGS

- A. Install in accordance with manufacturer's instructions and with ASTM C636; CISCA Seismic Guidelines.
- B. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.

- C. Apply ceiling in patterns indicated on Drawings. Verify alignment as work progresses.
 - 1. End Joint Pattern: Aligned and uniformly spaced to produce modular finished appearance.
- D. Install wood panels with undamaged edges and fit accurately onto suspension system runners. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.
 - 2. HVAC and Light Fixture Suspension: Support electrical and mechanical installations independent of wood suspended ceiling.
- E. Install perimeter trim as indicated on Drawings, and where ceiling terminates.

3.06 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.07 CLEANING

- A. Clean exposed surfaces of linear wood ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

3.08 PROTECTION

- A. Protect finish until Substantial Completion.

END OF SECTION

**SECTION 09 6513
RESILIENT BASE AND ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient wall base.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 2. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
 3. Verification Samples: Submit three samples, 12 inch (304.8 mm) in size illustrating color and pattern for each resilient flooring product specified.
- B. Closeout Submittals:
 1. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.03 MAINTENANCE MATERIALS

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.
 2. Clearly identify each package.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.05 MOCK-UPS

- A. Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Coordinate mock-ups in this Section with mock-ups specified in other Sections.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials in manufacturer's original unopened containers, with brand names and production lot numbers clearly marked.
- B. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.07 FIELD CONDITIONS

- A. Maintain air and wall temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C), in spaces to receive resilient products during the following time periods:
 1. 72 hours before installation.
 2. During installation.

3. After installation.

B. Install resilient base and accessories after other finishing operations, including flooring and painting have been completed.

1.08 WARRANTY

A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Resilient Base and Accessories: Provide manufacturer's warranty, as follows:

1. Materials: Minimum 5 years from Date of Substantial Completion.
2. Installation: Minimum 5 years from Date of Substantial Completion; warrant entire installation against loss of adhesion to substrates.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Refer to Finish Schedule for selected products.

B. Resilient Base Type RB-1, ASTM F1861, Type TS rubber, vulcanized thermoset; top set , and as follows:

1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
2. Style:
 - a. Style A, Straight: Carpeted areas.
 - b. Style B, Coved: Other flooring.
3. Height: 4 inch (100 mm).
4. Height: 6 inch (150 mm).
5. Thickness: 0.080 inch (2.0 mm) thick.
6. Finish: Satin.
7. Length: Roll.
8. Color: Color as selected by Owner from manufacturer's standards or as indicated on Finish Schedule.
9. Accessories: Premolded external corners and end stops.
10. Acceptable Manufacturers:
 - a. Burke Flooring: www.burkemercer.com.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - c. Roppe Corp.: www.roppe.com.
 - d. Prior approved equal.

2.02 ACCESSORIES

A. Adhesive: Water based type, zero (0) VOC content, spray application, water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Acceptable Manufacturer: Interlock Industries; Spray-Lock Adhesive: www.spraylock.com.
 - a. Substitutions: See Section 01 6000 - Product Requirements.

B. Use primers that comply the more stringent VOC limits of the current requirements of SCAQMD 1113 and Cal-GREEN Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.

C. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the current requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168.

1. Adhesives shall meet or exceed the VOC and chemical component limits of CAL-Green Table 5.504.4.1 Adhesive VOC Limit requirements.
2. Current requirement refers to the date on which the materials are installed in the building.

3. SCAQMD 1168 referenced in Section 018114 that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- D. Moldings and Edge Strips: Homogeneous vinyl or rubber type; tapered or bullnose edge; one inch wide; color selected by Architect.
 1. ReducerStrip Type 1: 1/8 inch to 0 inches, 1-1/2 inches wide.
 - a. Basis of Desifgn Product:
 - 1) Roppe Corporation; #45 Reducer Strip, 1/8".
 2. ReducerStrip Type 2: 5/16 inch to 0 inches, 1-5/16 inches wide.
 - a. Basis of Desifgn Product:
 - 1) Roppe Corporation;#25 Reducer Strip, 5/16"

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Ensure concrete has cured 60 days minimum.
 2. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
 3. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that gypsum board is finished to the floor and that gaps do not exist.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.
- E. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set base in place, press with heavy roller to attain full adhesion.

3.04 RESILIENT BASE

- A. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
 - 1. Pieces less than 10 feet (3 m) long are not permitted. Seams are not permitted between wall corners spaced less than 10 feet (3 m) apart.
- C. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Fit joints straight, tight, and vertical.
- E. Install on solid substrate backing.
- F. Bond tight to wall and floor surfaces.
- G. Scribe to door frames and other interruptions.
- H. Do not stretch resilient base during installation.
- I. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- J. Preformed Corners: Install preformed corners before installing straight pieces.
- K. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76.20 mm) in length.
 - a. Miter or Cope corners to minimize open joints.
- L. Fit joints tightly and make vertical. Install in longest lengths possible; maintain minimum dimension of 18 inches (45 mm) between joints.
- M. Align tops of adjacent sections.
- N. Change from cove base to straight base at flooring transition strips.
- O. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Immediately remove excess adhesive from surfaces without damage.
- C. Replace scuffed, scratched, broken, and discolored products.
- D. Re-install loose products.
- E. Clean surfaces in accordance with manufacturer's requirements. Do not use materials and methods which may damage finish and surrounding construction.

3.06 PROTECTION

- A. Protect work from damage from subsequent construction operations so there will be no indication of use and damage at time of acceptance.

END OF SECTION

**SECTION 09 6521
RESILIENT PLANK FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Solid vinyl floor plank.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: For each type of product.
 2. Shop Drawings: For each type of floor plank. Include floor plank layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - a. Show details of special patterns.
 3. Samples for Verification: Full-size units of each color and pattern of floor plank required.
 4. Product Schedule: For floor plank. Use same designations indicated on Drawings.
- B. Informational Submittals:
 1. Qualification Data: For Installer.
 2. Maintenance Data: For each type of floor plank to include in maintenance manuals.
- C. Closeout Submittals:
 1. Furnish extra plank, and resilient base in quantity equal to 2 percent of total material furnished but not less than:
 - a. One unopened box of plank for each 50 boxes or fraction thereof installed of resilient plank of each type, pattern and color.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 3. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.
 4. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- B. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor plank installation method indicated.
 1. Engage an installer who employs workers for this Project who are trained or certified by floor plank manufacturer for installation techniques required.
- C. Prior to installation, Owner's independent testing laboratories to perform recommended calcium chloride moisture and alkalinity tests on concrete slabs. If required, moisture barrier will be applied prior to flooring installation.

- D. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E662.
- E. Flooring shall have been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- F. Floor Tile Slip Resistance: Comply with ANSI A137.1, 2012 edition Dynamic Coefficient of Friction AcuTest of 0.42 wet as tested with BOT-3000 Universal Walkway Tester.

1.05 MOCK-UPS

- A. Mock-ups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mock-ups for floor plank including accessories.
 - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern as directed by Architect.
 - 2. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store floor plank and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor planks on flat surfaces.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor plank during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor plank installation.
- D. Close spaces to traffic for 48 hours after floor plank installation.
- E. Install floor plank after other finishing operations, including painting, have been completed.

1.08 SEQUENCING

- A. Install products after other finishing operations, including painting, have been completed.
- B. Do not install resilient products on top of concrete slabs until they are cured and are sufficiently dry to achieve bond with adhesive as determined by resilient material manufacturer's recommended bond and moisture test.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient plank flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
- B. FloorScore Compliance: Resilient plank flooring shall comply with requirements of FloorScore certification.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volaplanck Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Provide resilient flooring which complies with fire resistance ratings for locations scheduled on Drawings.
 - 1. Critical radiant flux:
 - a. Test method: ASTM E648.
 - b. Value: Not less than 0.22 watts per square centimeter.
 - 2. Flame spread:
 - a. Test method: ASTM E84.
 - b. Index: 25 or less.
 - 3. Flooring, base, and related elements shall not continue to propagate fire.
 - 4. Smoke generated:
 - a. Test method: ASTM E662.
 - b. Index: 450 or less.

2.02 SOLID VINYL FLOOR PLANK

- A. Refer to Finish Schedule for selected products.
- B. Acoustical Underlayment: Provide manufacturer's standard acoustical underlayment.
- C. Vinyl Plank Flooring :
 - 1. Layered vinyl wear layer with print layer on a solid vinyl backing. Protected UV-cured polyurethane finish. ASTM F 1700, "Standard Specification for Solid Vinyl Tile", Class III, Type B - Embossed Surfaces.
 - 2. Size: 6 inches (150 mm) by 36 inches (914 mm).
 - 3. Thickness: 8.0 mm.
 - 4. Wear Layer Thickness: 20 mil (0.5 mm).
 - 5. Installation: Floating click.

2.03 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor plank manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor plank and adhesive manufacturers to suit floor plank and substrate conditions indicated.
 - 1. Adhesives shall comply with the following limits for VOC content:
 - a. Resilient plank Adhesives: 50 g/L or less.
 - 2. Use primers that comply the more stringent VOC limits of the current requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 3. LEED Requirements - LEED Credit EQc4.1 - Adhesives and Sealants shall meet low VOC content as determined by LEED requirements; VOC content shall not exceed 50 grams/liter.
 - 4. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the current requirements of SCAQMD 1168.

- a. Adhesives shall meet or exceed the VOC and chemical component limits of CAL-Green Table 5.504.4.1 Adhesive VOC Limit requirements.
- b. Current requirement refers to the date on which the materials are installed in the building.
- c. SCAQMD 1168 referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor plank.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to floor plank manufacturer's written instructions to ensure adhesion of resilient products.
- B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 - 1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
 - 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor planks until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor plank and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor plank.

3.03 FLOOR PLANK INSTALLATION - GENERAL

- A. Comply with manufacturer's written instructions for installing floor plank.
- B. Lay out floor planks from center marks established with principal walls, discounting minor offsets, so planks at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half plank at perimeter.
 - 1. Lay planks in pattern indicated.
- C. Match floor planks for color and pattern by selecting planks from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed planks.
 - 1. Lay planks with grain running in one direction.
- D. Scribe, cut, and fit floor planks to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

- E. Extend floor planks into toe spaces, door reveals, closets, and similar openings. Extend floor planks to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor planks as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor planks on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of plank installed on covers and adjoining planks. Tightly adhere plank edges to substrates that abut covers and to cover perimeters.

3.04 ADHERED FLOOR PLANK INSTALLATION

- A. Installation over gypsum cement underlayment: Seal floor prior to installation of plank floor with gypsum underlayment manufacturer's approved product.
- B. Adhere floor planks to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor plank.
- B. Perform the following operations immediately after completing floor plank installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor plank from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Joint Sealant: Apply sealant to resilient plank floor perimeter and around columns, at door frames, and at other joints and penetrations.
- E. Cover floor plank until Substantial Completion.

END OF SECTION

**SECTION 09 6623
RESINOUS MATRIX TERRAZZO FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Epoxy matrix terrazzo with ground and polished finish.
- B. Divider strips.
- C. Precast epoxy terrazzo thresholds.
- D. Precast epoxy terrazzo stair units.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Attendance:
 - a. Owner's representative.
 - b. Architect.
 - c. Contractor.
 - d. Resin manufacturer's representative.
 - e. Installer performing the pouring, grinding, and polishing.
 - f. Other parties affected by the work of this Section.
 - 2. Agenda:
 - a. Review contract document requirements.
 - b. Review requirements for assessment of sound substrate and subsequent remediation in the case of sub-standard conditions.
 - c. Review requirements for environmental conditions and storage of materials.
 - d. Review terrazzo resin manufacturer's preparation and application instructions including, but not limited to, the following:
 - 1) Procedures for proper substrate preparation.
 - 2) Mix design and matching of approved samples.
 - 3) Schedule and availability of materials, personnel, and equipment.
 - 4) Pour of the epoxy matrix.
 - 5) Protecting terrazzo surfaces until grinding/polishing begins.
 - 6) Details of each step of grinding, honing, and polishing operations.
 - 7) Sealing and protecting terrazzo after polishing is completed.
 - 3. Review conditions or techniques which would prevent the satisfactory application of the terrazzo system.
 - 4. Reports: record discussions, including decisions and agreements reached, and furnish copy of record to each party in attendance.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide data for divider strips, control joint strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for type of terrazzo specified.
 - 2. Shop Drawings: Indicate divider strip and control and expansion joint layout, and details of adjacent components. For precast units, detail profile and anchorage requirements.
 - 3. Samples: Submit three samples, 8 inch (203 mm) by 8 inch (203 mm) in size illustrating color, chip size and variation, chip gradation, matrix color, and typical divider strip.
- B. Informational Submittals:
 - 1. Manufacturer's Qualification Statement.
 - 2. Installer's Qualification Statement.

- C. Closeout Submittals:
 - 1. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 5.504.4.1 Adhesives and sealants.
 - 2. 5.504.4.3 Paints and coatings.
 - 3. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 4. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 5. Section A5.405.5: Provide documentation that cement and concrete used are made with recycled content and/or alternative energy.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NTMA recommendations as posted at their web site at www.ntma.com.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this Section.
 - 1. Minimum five years of documented experience.
 - 2. Approved by matrix manufacturer.
- C. Prior to installation, testing laboratories to perform moisture vapor emission testing in accordance with Section 09 0561 - Common Work Results for Flooring Preparation. If required, apply moisture barrier prior to flooring installation.
- D. Walkway Auditor: Certified by CPAA or NFSI to test bonded abrasive polished concrete floors for wet dynamic coefficient of friction according to ANSI B101.3.
 - 1. Coefficient of Friction: Achieve following coefficient of friction by field quality control testing in accordance to the following standards:
 - a. ANSI B101.3 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials - Achieve a minimum of 0.42 for level floor surfaces.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000.
- B. Mock-up: Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 6 feet by 6 feet.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store terrazzo materials in a dry, secure area.
- B. Maintain minimum temperature of 55 degrees F (13 degrees C).
- C. Keep products away from fire or open flame.

1.08 FIELD CONDITIONS

- A. Do not install terrazzo when temperature is below 50 degrees F (10 degrees C) or above 90 degrees F (32 degrees C).
- B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.
- C. Provide ambient lighting level of 50 ft candles (540 lx), measured at floor surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Products:
 - 1. Concord Terrazzo Company, Inc.; TERRAZZCO EZpour Epoxy 158: terrazzco.com.
 - 2. Crossfield Products Corp; Dex-O-Tex Spectrum Key Resin Company: www.keyresin.com.
 - 3. Sherwin-Williams Company; General Polymers Brand: www.generalpolymers.com.
 - 4. Terrazzco; TERRAZZCO Epoxy Terrazzo System, a brand of Concord Terrazzo Company, Inc: www.terrazzco.com.
 - 5. Approved equal.

2.02 EPOXY MATRIX TERRAZZO APPLICATIONS

- A. Floors: Locations: Elevator and as indicated on Drawings.
 - 1. Thickness: 3/8 inch (9 mm), nominal.
 - 2. Aggregate Type: Marble chips.
 - 3. Aggregate Size: Match Architect's sample.

2.03 MATERIALS

- A. Epoxy Matrix Terrazzo: Aggregate and matrix mix applied to substrate, troweled flat, and ground smooth.
 - 1. Mix Proportions: As required to achieve appearance specified.
- B. Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.
 - 1. Physical Properties without Aggregates:
 - a. Hardness: 60 to 85 per ASTM D2240, Shore D.
 - b. Minimum Tensile Strength: 3000 psi (20.7 MPa) per ASTM D638 for a 2 inch (51 mm) specimen made using a "C" die per ASTM D412.
 - c. Minimum Compressive Strength: 10,000 psi (6.9 MPa) per ASTM D695, Specimen B cylinder.
 - d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.
 - e. Distilled water.
 - f. Mineral water.
 - g. Isopropanol.
 - h. Ethanol.
 - i. 0.025 percent detergent solution.
 - j. 5 percent acetic acid.
 - k. 10 percent sodium hydroxide.
 - l. 10 percent hydrochloric acid.
 - 2. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4-inch (6.35-mm) nominal thickness, and cured for 7 days at 75 deg F (24 deg C) plus or minus 2 deg F (1 deg C) and at 50 percent plus or minus 2 percent relative humidity.

- a. Flammability: Self-extinguishing, maximum extent of burning 1/4 inch (6.35 mm) according to ASTM D635.
 - b. Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C) according to ASTM C531.
- C. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
- 1. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
 - 2. 24-Hour Absorption Rate: Less than 0.75 percent.
 - 3. Dust Content: Less than 1.0 percent by weight.
 - 4. Finishing Grout: Epoxy, color to match terrazzo matrix.
- D. Aggregate: Type as indicated; sized in accordance with NTMA aggregate gradation standards; colors as indicated, uniform in color.
- E. Finishing Grout: Epoxy, color to match terrazzo matrix.
- F. Precast Epoxy Terrazzo Stair Units: Fabricate to sizes and profiles indicated on Drawings.
- 1. Nosing: Contrasting strip at leading edge.
 - 2. Reinforcing: As indicated on Drawings.
 - 3. Setting Material: Latex Portland cement mortar, ANSI A118.4.

2.04 PRECAST EPOXY MATRIX TERRAZZO APPLICATIONS

- A. Stairs - Treads and Risers:
- 1. Thickness: 1-1/2 inch (38 mm), minimum.
 - 2. Color(s): As indicated on Finish Schedule.
 - 3. Aggregate Type and Size: Same as floors.

2.05 ACCESSORIES

- A. Precast Epoxy Terrazzo Thresholds: 2 inches (51 mm) thick; beveled edge on both long edges; without holes, cracks, or open seams.
- 1. Width: As indicated on Drawings.
 - 2. Length: Full width of opening.
 - 3. Provide abrasive strips as shown on Drawings.
 - 4. Color and Pattern: As indicated on Drawings.
 - 5. Applications:
 - a. As indicated on Drawings.
 - 6. Installation: Thickset.
- B. Divider Strips: 1/8 inch (3 mm), 1/4 inch (6 mm), and 1/2 inch (12.7 mm) thick zinc exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.
- C. Control Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- D. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding,
- E. Strip Adhesive: 100% solids epoxy resin adhesive recommended by manufacturer.
- 1. Use adhesive that has a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Abrasive Strips: Three-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
- 1. Width: 1/2 inch (12.7 mm).
 - 2. Depth: As required by terrazzo thickness.
 - 3. Length: 4 inches (100 mm) less than stair width.
 - 4. Color: As selected by Architect from full range of industry colors.

- G. Anchoring Devices:
 1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
- H. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- I. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- J. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated
- K. Sealer: Colorless, non-yellowing, penetrating liquid type to completely seal matrix surface; not detrimental to terrazzo components.
 1. Solvent Based Sealer Properties: Flashpoint at 80 deg. F or above according to ASTM D 56.
 2. Water Based Sealer Properties: With pH factor between 7 and 10.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive terrazzo.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive terrazzo.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- D. Verify that wood subfloors have 12 percent maximum moisture content.
- E. Cementitious Subfloor Surfaces: Verify that substrates are ready for terrazzo flooring installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
 2. Obtain instructions if test results are not within limits recommended by terrazzo flooring manufacturer.
- F. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Test in accordance with Section 09 0561.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- G. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Clean substrate of foreign matter.
- B. Prepare concrete subfloor by mechanically abrading surface in accordance with manufacturer's instructions.
- C. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.
 1. Prepare and prefill substrate cracks with membrane material.
 2. Install membrane at substrate cracks in areas to receive terrazzo.
 3. Reinforce membrane with fiberglass scrim.

- D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.
- E. Apply primer in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install divider strips according to pattern approved on shop drawings.
- B. Install divider and control joint strips straight and flat to locations indicated.
 1. Locate divider strips in locations indicated.
 2. Install control-joint strips back to back and directly above concrete-slab control joints in locations indicated.
 3. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
 4. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 5. Accessory Strips: Install as required to provide a complete installation in locations indicated.
- C. Apply primer to terrazzo substrates according to manufacturer's written instructions.
- D. Place terrazzo mix over substrate to thickness indicated.
- E. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
 1. Installed Thickness: 3/8 inch (9.5 mm) nominal.
- F. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.
- G. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.
- H. Anchor precast units as indicated on drawings.
- I. Install precast units using specified setting material.

3.04 FINISHING

- A. Finish terrazzo to NTMA requirements.
- B. Produce terrazzo finish surface to match approved mock-up, with 70 percent chip exposed.
- C. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using a wet method.
- D. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
 1. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
 2. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
 3. According to NTMA, the standard finish on portland cement terrazzo is an 80-grit carborundum polish. 120 grit produces a more highly polished surface and tends to deepen and darken the appearance of aggregates.

4. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with [80] [120]-grit stones or with comparable diamond abrasives until grout is removed from surface.

- E. Apply grout to fill voids exposed from grinding.
- F. Remove grout coat by grinding, using a fine grit abrasive.
- G. Hand grind vertical and curved surfaces similarly.
- H. Slip Resistance: Unless approved otherwise, measured dynamic coefficient of friction (DCOF) shall be not less than 0.42 (wet) at the time of testing as measured using a Regan Scientific Instruments Bot-3000e Tribometer, in accordance with ANSI B101.3.

3.05 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo threshold and stair units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.
- B. Install precast units using specified setting material.
- C. Do not install units that are chipped, cracked, discolored, or improperly finished.
- D. Seal joints between units with joint compound matching precast terrazzo matrix and joint sealant.

3.06 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.07 TOLERANCES

- A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet (6 mm in one m).
- B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch (3 mm).

3.08 FIELD QUALITY CONTROL

- A. Field Testing: Engage a qualified walkway auditor to perform field testing to determine if in-place floor finish complies with specified coefficient of friction.
- B. Slip Resistance Measurements:
 - 1. Take slip resistance measurements prior to Owner possession.
 - 2. Test method shall conform to ansi/nfsi b101.3-2012.
 - 3. Provide a minimum of 2 tests for every 1000sf of polished concrete floor area, with a maximum dimension between tests locations of 30 feet o.c.; provide even distribution of testing throughout.
 - 4. Collect and record slip resistance measurements on floor plan and submit with closeout documents as specified.
 - 5. Within 24 hours of testing, notify the Architect of all non-conforming measurements.

3.09 CLEANING

- A. Scrub and clean terrazzo surfaces with neutral pH cleaner in accordance with manufacturer's instructions. Let dry.
- B. Immediately after terrazzo has dried, apply sealer in accordance with manufacturer's instructions.
- C. Polish surfaces in accordance with manufacturer's instructions.

3.10 PROTECTION

- A. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

END OF SECTION

**SECTION 09 6700
FLUID-APPLIED FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-applied flooring and base.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
 2. Samples: Submit two samples, 12 by 12 inches (305 by 305 mm) in size illustrating color and pattern for each floor material for each color specified.
- B. Informational Submittals:
 1. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
 2. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - a. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 2. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section.
 1. Approved by manufacturer.
- C. Prior to installation, provide testing laboratories to perform recommended calcium chloride moisture and alkalinity tests on concrete slabs. If required, apply moisture barrier prior to flooring installation.
- D. Walkway Auditor: Certified by CPAA or NFSI to test bonded abrasive polished concrete floors for dynamic and static coefficient of friction according to ANSI B101.1 and B101.3.
- E. Coefficient of Friction: Achieve following coefficient of friction by field quality control testing in accordance to the following standards:
 1. ANSI B101.3 Wet Dynamic Coefficient of Friction - Achieve a minimum of 0.42 for level floor surfaces.

1.05 MOCK-UP

- A. Construct mock-up of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
 1. Number of Mock-Ups to be Prepared: One.
 2. Use same materials and methods for use in the work.
 3. Locate where directed.

- 4. Size and Location: As directed by Architect.
- B. Obtain approval of mock-up by Architect before proceeding with work.
- C. Approved mock-up may not remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Slip resistance of floor system as measured by the following criteria:
 - 1. Wet Dynamic Coefficient of Friction (DCOF): Provide products with the following value as determined by testing identical products by the DCOF AcuTest Method per ANSI 137.1, 2012 Edition.
 - a. Walkway Surfaces: Minimum 0.42.

2.02 FLUID-APPLIED FLOORING SYSTEMS

- A. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of South Coast Air Quality Management District SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
 - b. Flats: 50 grams per liter of product minus water.
 - c. Non-flats: 100 grams per liter of product minus water.
 - d. Non-flat High Gloss: 150 grams per liter of product minus water.
- B. Fluid-Applied Flooring: Polyurethane, four component resin; with aggregate.
 - 1. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - a. Total Thickness: 1/4 inch minimum.
 - b. Compressive Strength: 7,700 psi after 7 days per ASTM C 579.
 - c. Tensile Strength: 1,000 psi per ASTM C 307.
 - d. Flexural Strength: 2,400 psi per ASTM C 580.
 - e. Water Absorption: Less than 1 percent per ASTM C 413.
 - f. Impact Resistance: Greater than 160 in. lbs. per ASTM D 2794.
 - g. Flammability: Class 1 per ASTM E-648.
 - h. Hardness: 80 to 84, Shore D per ASTM D 2240.
 - 2. Mortar Coat:
 - a. Thickness: 3/16 inch (5 mm)
 - b. Number of Coats: One.
 - c. Color: As selected by Architect from manufacturer's full range.
 - d. Basis of Design Product:
 - 1) Stonhard, Inc.; Stonclad UT.

3. Top Coat: Two part, UV resistant, urethane.
 - a. Number of Coats: One.
 - b. Color: As selected by Architect from manufacturer's full range.
 - c. Basis of Design Product:
 - 1) Stonhard, Inc.; Stoneseal UT7.
4. Decorative Aggregate: Quartz granules.
 - a. Broadcast to rejection
 - b. Basis of Design Product:
 - 1) Stonhard, Inc. Pigmented Blended aggregate.
5. Basis of Design Product:
 - a. Stonhard, Inc.; Stoneclad UT.

2.03 ACCESSORIES

- A. Repair Materials for Existing Concrete Floors:
 1. Pitching and Leveling: Use four component fast setting urethane grout.
- B. Repair Materials for Existing Concrete Floors:
 1. Minor Patching and Small Cracks: 100 percent solids epoxy and fumed silica.
 2. Major Patching and Large Cracks (1/4 inch (6.35 mm)): 100 percent solids epoxy.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Ensure concrete has cured 60 days minimum.
 2. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
 - a. Employ a radio frequency moisture meter to determine that residual uncombined moisture content of concrete slab is less than 5 percent by weight. Conduct ASTM F1869 to further record the Moisture Vapor Emission Rate. Do not apply high performance floor coatings to floor slabs that exceed 5 percent moisture content or 3 pounds per 1,000 square feet per 24 hours unless approved by the material manufacturer.
 3. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare and clean in accordance to flooring manufacturer's instructions for particular substrate conditions involved, and as specified.
 1. Prepare concrete surfaces in accordance with ASTM D4258.
- B. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
 1. Patch material shall be approved by flooring manufacturer.
- C. Mechanical Surface Preparation:
 1. Mechanically abrade concrete surface in accordance with manufacturer's instructions.
 2. Leave concrete surface with an aggressive texture.
 3. Remove concrete dust.
 4. Conform to ASTM D4259.
 5. Surface profile shall conform to IRCI Guideline 03732 CSP 3, minimum
- D. Crack Repair: For Cracks over 1/16 inch (1.58 mm) wide after surface preparation.

1. Route top of crack to 1/2 inch (12.70 mm) by 1/4 inch (6.35 mm) minimum. Insure walls of crack are clean, dry, and free from contaminates, use grinder blade to clean side walls if required.
2. Prime down into prepared crack and extending out 2 inches (50.8 mm) minimum on both sides of crack.
3. Apply second coat into crack to fill areas that have settled from first application. Apply strip coat 2 inches (50.8 mm) minimum on both sides of crack.
 - a. Thickness: 40 mils (1.0 mm), feather edges.
4. If application is free from sink holes apply fiber reinforced fabric onto surface of strip coat application. If application has sink holes make another application before applying fabric reinforcement.

E. Vacuum clean substrate.

F. Etch concrete floor in accordance with manufacturer's instructions.

3.03 INSTALLATION - FLOORING

A. Apply flooring system in accordance with manufacturer's instructions.

B. Apply flooring system materials to obtain consistent thickness and smooth, uniform appearance and texture.

C. Apply cove base mix to wall surfaces 6 inches high before applying flooring. Round internal and external corners.

D. Basecoat: Apply basecoat 3/16 inch (5 mm) thick.

1. Cure fluid-applied flooring according to manufacturer's written instructions. Prevent contamination during application and curing processes.
2. At substrate expansion and isolation joints, provide joint in fluid-applied flooring to comply with manufacturer's written recommendations.
3. Broadcast desired light texture directly into mortar base.

E. Topcoat: Once basecoat is cured, apply top coat.

F. System total thickness: 1/4 inch (6.35 mm) minimum.

3.04 FIELD QUALITY CONTROL

A. Refer to Section 01 4000 - Quality Requirements, for additional requirements.

B. Field Testing: Engage a qualified walkway auditor to perform field testing to determine if polished concrete floor finish complies with specified static coefficient of friction.

1. ANSI B101.3 for dynamic coefficient of friction.

3.05 ADJUSTING

A. Repair or replace adjacent Work which has been damaged by finishing operations.

3.06 CLEANING

A. Clean-up and remove debris daily.

B. Clean spillage, overspray, or drift from adjacent surfaces; remove immediately in accordance with manufacturer's instructions.

3.07 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to protect flooring until fully cured.

END OF SECTION

**SECTION 09 8100
ACOUSTIC INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Acoustical batt insulation.
- B. Acoustical rigid fiber glass board insulation.
- C. Acoustical duct wrap.

1.02 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM method below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristic: ASTM E84.
 - 2. Fire Resistance Ratings: ASTM E119.
 - 3. Combustion Characteristics: ASTM E136.
- B. Single-Source Responsibility for Acoustical Insulation Products: Obtain each type of acoustical insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 2. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
 - 3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 PRODUCTS

2.01 GENERAL

- A. General: Comply with regionally-sourced, recycled content, urea-formaldehyde prohibition, adhesives and sealants, aerosol adhesives, and volatile organic compound (VOC) product requirements specified in Section 018114 - Greenhouses.
 - 1. 25% postconsumer or 50% pre-consumer recycled content.
- B. Acoustic Insulation - General: Use type of acoustical insulation to comply with indicated assembly requirements.

1. Where any specified rated assembly requires the use of proprietary acoustical insulation products, installation methods or procedures, comply with specified rated assembly requirements including requirements associated with assembly options which may be selected by Contractor.

2.02 BATT INSULATION

- A. Fiberglass Acoustic Insulation: ASTM C665, Type I, unfaced, non-combustible as per ASTM E 136.
 1. Inorganic glass fiber material with a minimum density of 0.60 pounds per cubic foot.
 2. Surface Burning Characteristics as per ASTM E 84: Flame Spread of 25; Smoke Developed of 50.
 3. Density: Minimum 2.0 pounds per cubic foot where used in rated floor/ceiling assembly and specified wall assemblies.
 4. Thickness: Full thickness of indicated wall framing, and 3-1/2 inches thick to comply with specified floor/ceiling assembly rating requirements.
 5. Widths: Match stud spacing and be self supporting between the studs.
 - a. For application above ceilings, select batt widths to be supported on ceiling construction over the entire ceiling area.
 6. Do not provide paper or other combustible backing or facing on batts.
 7. Select batt thickness to fill cavity airspace.
 8. Acceptable Products:
 - a. CertainTeed Corporation; CertaPro AcoustaTherm Batt.
 - b. Johns Manville; Sound-Shield Sound Control Batt.
 - c. Owens-Corning; Sound Attenuation Batt Insulation.
 - d. Prior approved equal.
- B. Mineral Fiber Acoustic Insulation: ASTM C612; semi-rigid mineral fiber, unfaced; flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Thickness:
 - a. Full thickness of indicated wall framing.
 - b. 2 inch (50.8 mm) minimum or as indicated on Drawings for mechanical rooms.
 2. Density: Minimum 2.4 pounds per cubic foot where used in specified wall assemblies.
 3. Acceptable Products:
 - a. Roxul, Inc.; Safe'n'Sound: www.roxul.com.
 - b. Prior approved equal.

2.03 ACOUSTICAL DUCT WRAP FOR BREAKOUT NOISE CONTROL

- A. Acoustic Duct/Pipe/Conduit Wrap:
 1. Thickness: 1 inch (25 mm).
 2. Basis of Design Product:
 - a. Sound Seal model B-20 LAG/QFA sound proofing pipe and duct wrap.
 - b. Kinetics Noise Control model KNM-200ALQ/KFA
 - c. Equal products of other manufacturers when approved in advance by the Architect.
 - d. Approved equal.

2.04 ACCESSORIES

- A. Acoustic Sealant: As specified in Section 07 9219 - Acoustical Joint Sealants.
- B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
 3. Products:
 - a. AGM Industries, Inc; Series T TACTOO Insul-Hangers.

- b. Gemco; Spindle Type.
 - c. Approved equal.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square.
 - 1. Products:
 - a. AGM Industries, Inc;; SC150.
 - b. Gemco;; S-150.
 - c. Approved equal.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
 - 1. Products:
 - a. AGM Industries, Inc; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.
 - c. Approved equal.
- E. Provide other materials, not specifically described but required for a complete and proper installation, as recommended by the Manufacturer, and subject to the approval of the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.03 INSTALLATION

- A. Install accordance with manufacturer's recommendations, eliminating gaps, butting joints, tying or attaching fiberglass in place where it is not self supporting.
- B. Extend insulation full thickness to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- C. At Penetrations:
 - 1. Seal penetration of acoustical partitions by ductwork, cable, conduit or pipes. Cover gaps larger than 1/2 inch (12.70 mm) with gypsum board, lapped 2 inches (50.8 mm) minimum, and screwed before using acoustical sealant. Seal gaps in accordance with Section 079219 - Acoustical Joint Sealants.
 - 2. Cable Trays: Provide conduit sleeves at slab to slab partitions penetrated by cable trays. Flexible duct, pipe and conduit connections should be incorporated between rooms where resiliently isolated floors, walls, or ceilings occur.

3.04 INSTALLATION OF BOARD INSULATION BELOW ROOF/CEILING DECK

- A. Install insulation in accordance manufacturer's written instructions.
- B. Adhere impaling clip in accordance with manufacturer's recommendations.
- C. Impale insulation onto impaling clip. Butt joints tight. Install retaining washer.

3.05 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 09 8414

ACOUSTIC STRETCHED-FABRIC WALL AND CEILING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Acoustic stretched-fabric wall system.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
 - d. Specimen warranty.
 - 2. Shop Drawings: Details indicating typical transitions to other finish surfaces.
 - a. Elevations indicating proposed locations of fabric seams and details indicating typical transitions to other finish surfaces.
 - 3. Selection Samples: Fabric swatches representing manufacturer's full range of available colors, textures, and patterns.
 - 4. Verification Samples:
 - a. For each fabric specified, minimum size 12 inch (305 mm) square, representing actual product in color, texture, and pattern.
 - b. Actual samples of each frame profile to be used, including transitions between dissimilar profiles.
 - c. Acoustic material, minimum size 12 inch (305 mm) square.
 - d. Accessory package.
- B. Informational Submittals:
 - 1. Test Reports: Certified test data from an independent test agency verifying that wall systems meet specified requirements for acoustical and fire performance.
 - 2. Manufacturer's Qualification Statement.
 - 3. Installer's Qualification Statement.
 - 4. Maintenance Contract.
 - 5. Warranty Documentation: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Supply an additional 10 (ten) percent of accessories installed for Owner's use in maintenance of project.
 - 2. Supply an additional 5 (five) percent of fabric installed for Owner's use in maintenance of project.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. A5.405.1 Regional materials. Select building materials or products for permanent installation on the project that have been harvested or manufactured in California or within 500 miles of the project site, meeting the criteria listed in Section A5.405.1.

3. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
4. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.05 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4000.
- B. Mock-Up: Provide a mock-up for evaluation of applicable workmanship.
 1. Finish areas as designated by Architect.
 2. Do not proceed with remaining work until workmanship and overall appearance are approved by Architect.
 3. Refinish mock-up area as required to produce acceptable workmanship.
 4. Approved mock-up may remain as part of the completed work.
 5. Construct mock-up of acoustic stretched-fabric wall system at location indicated by Architect.
 - a. Minimum mock-up dimensions; 96 by 96 inches (2440 by 2440 mm).
 - b. Approved mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect fabric, acoustical backing, and track from excessive moisture in shipment, storage, and handling.
- B. Do not deliver materials to project until wet work such as concrete and plaster has been completed.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 MOCK-UP

- A. Construct mock-up of acoustic stretched-fabric wall system at location indicated by Architect.
 1. Minimum mock-up dimensions; 36 by 36 inches (914 by 914 mm).
 2. Approved mock-up may not remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Do not begin installation until interior conditions have reached temperature and humidity that will be maintained during occupancy.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work for lifetime of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer:
 1. FabriTRAK Systems, Inc; FabriTRAK System: www.fabritrak.com.

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2. Other Acceptable Manufacturers:
 - a. Fabric Wall: www.fabric-wall.com.
 - b. Fabricmate Systems: www.fabricmate.com.
 - c. Novawall Systems, Inc: www.novawall.com.
 - d. Prior approved equal.

2.02 ACOUSTIC STRETCHED-FABRIC SYSTEM

- A. Acoustic Stretched-Fabric Wall System: Field installed, fabric is stretched and set into framework and laid over acoustic material anchored to substrate. Framework consists of continuous perimeter and intermediate mounting frames anchored to substrate, and designed to permit removal and replacement of fabric within framed areas without affecting adjacent areas.
 1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum; when whole system is tested in accordance with ASTM E84 using mounting specified in ASTM E2573 for stretched systems.
 2. Noise Reduction Coefficient (NRC): 0.80, minimum, when tested in accordance with ASTM C423, Type A mounting per ASTM E795.
 3. Prefabricated, fabric covered and individually framed panels are not permitted.
 4. Install fabric over acoustic material and into framework without use of adhesives, tapes, or fasteners.
 5. Seams in fabric are not permitted; base the frame layout dimensions on fabric at least 72 inch (1.83 m) wide.
- B. Provide materials and systems made of recycled content, at least 90 percent post-consumer or pre-consumer (post-industrial).
- C. Verify that adhesives and sealants used in installation of acoustic stretched-fabric system have acceptable low VOC emission ratings.

2.03 MATERIALS

- A. Refer to Finish Schedule for selected products and finishes.
- B. Frame:
 1. Framing System: Extruded polymer framing system with serrated jaws of sufficient strength to hold fabric in place after repeated applications.
 2. Frame Color: As selected from manufacturer's standard colors.
- C. Acoustic Material:
 1. Provide type of acoustic material in thickness required to achieve Noise Reduction Coefficient (NRC) indicated.
 2. Ensure that thickness of acoustic material fills depth of frame as necessary for application without use of support blocking.
 3. Tackable Multi-Density Fiberglass Board: Consisting of 1/8 inch thick facing sheet of 18 to 22 lbs/cu ft (24.3 kg/cu m) density laminated over compressed fiberglass board, Class A fire rated in accordance with ASTM E84, with square edge in 48 inch by 48 inch (1220 mm by 1220 mm) panels.
 - a. Overall Thickness: 1 inch (25.4 mm).
 - b. Product:
 - 1) FabriTRAK Systems, Inc.; FabriTack.
 4. Overall Thickness: 1 inch (25.4 mm).
 5. Non-Tackable Polyester Fiber Board: Low denier polyester fiber board, Class A fire rated in accordance with ASTM E84.
 - a. Overall Thickness: 1 inch (25 mm).
 - b. Product:
 - 1) FabriTRAK Systems, Inc.; TerraCore Poly.

- D. Fabric: Heavy-duty fire-retardant commercial fabric, as provided by manufacturer of acoustic stretched-fabric system; color, pattern, and texture as selected from system manufacturer's fabric supplier's standard line of fabric.
 - 1. Connect membrane together by factory welds to achieve the appropriate size.
 - 2. Fabric: As indicated on Finish Schedule.
- E. Fasteners: As recommended by manufacturer of acoustic stretched-fabric system in accordance with project requirements.
- F. Adhesives: Only use adhesives that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District SCAQMD 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. A copy of SCAQMD 1168 is referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- G. Adhesives: Low VOC or water-based, and approved by acoustic stretched-fabric system manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Begin installation only after substrates have been properly prepared.
- B. Verify that casework, markerboards, door and window jambs, finished ceiling, and other finished items adjacent or abutting the acoustic stretched-fabric system have been properly installed.
- C. When preparation of substrate is the responsibility of another installer, notify Architect of unsatisfactory preparation prior to proceeding with this work.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation of this work.
- B. Prepare substrate surfaces using methods as recommended by the manufacturer for achieving acceptable result as required for this work.
- C. Remove wall plates and other obstacles, and properly prepare substrates to receive frames and acoustic material in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install acoustic stretched-fabric system at locations indicated in accordance with manufacturer's instructions.
- B. Frames: Install perimeter and intermediate frames using appropriate fasteners for prepared substrate, firmly secured to ensure frames do not separate from substrate.
 - 1. For tile or masonry substrates, apply continuous bead of adhesive along base of framing in addition to spacing of conical anchors and/or fasteners at 6 to 8 inches (152 to 203 mm) on center.
 - 2. Follow contours of wall and scribe to adjoining work at borders, penetrations, and imperfections.
 - 3. Install framing around openings and penetrations.
 - 4. Allow for spacing of framework to accommodate insertion of installation tool.

- C. Acoustic Material: Cut and trim acoustic material to fit snugly within perimeter and intermediate framework.
 - 1. Apply adhesive and press acoustic material into place, maintaining constant plane.
- D. Fabric: Stretch fabric over acoustic material, locking edges of fabric into frame's serrated jaws using manufacturer's recommended tool. Maintain fabric weave plumb, level and true, in proper relation to building lines, without ripples, waviness, hourglass, or other deleterious effects.
 - 1. Upon fabric installation, do not employ adhesives or mechanical fasteners of any type, and ensure fabric is free-floating and in contact with acoustic material as necessary.
 - 2. Stapling or gluing of fabric to cores or channel framework is not permitted.
 - 3. Provide tension in fabric sufficient to prevent sagging under anticipated changes in temperature and humidity.

3.04 CLEANING

- A. Clean exposed surfaces of acoustic stretched-fabric system in compliance with manufacturers instructions for cleaning and repair of minor damage to exposed surfaces.

3.05 PROTECTION

- A. Protect installed materials upon completion of this work, using methods that will ensure that the finished work is without damage or deterioration upon Date of Substantial Completion.

END OF SECTION

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SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL**1.01 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
- B. Surface preparation and field painting of exposed items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - 2. Field finish coating of shop or factory primed and prefinished items. Refer to individual Sections for priming requirements.
 - 3. Finish coatings schedule.
 - 4. Preparation work and coatings specified in this Section are in addition to shop and factory applied finishes and surface treatment specified in other Sections.
 - 5. Paint all other items unless specifically indicated not to be painted.
 - 6. Color schedule.
- C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

1.02 DEFINITIONS

- A. Conform to PDCA Glossary for interpretation of terms used in this Section except as modified below.
- B. Exposed Surfaces: Surfaces of products, assemblies, and components visible from any angle after final installation. Includes internal surfaces visible when operable doors, panels or drawers are open, and surfaces visible behind registers, grilles, or louvers.
- C. Concealed Surfaces: Surfaces permanently hidden from view in finished construction and which are only visible after removal or disassembly of part or all of product or assembly.
- D. Inaccessible Spaces: Spaces not intended for human use.
 - 1. Standard terms used by the coatings industry are defined in ASTM D16.
- E. Gloss Levels according to ASTM D523:
 - 1. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees.
 - 2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 3. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 4. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
 - 5. Gloss Level 5: 35 to 70 units at 60 degrees.
 - 6. Gloss Level 6: 70 to 85 units at 60 degrees.
 - 7. Gloss Level 7: More than 85 units at 60 degrees.
- F. System DFT: Dry film thickness of entire coating system unless otherwise noted.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each paint system indicated. Include block fillers and primers.

- a. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
- b. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- 2. Samples for Initial Selection: For each type of topcoat product.
- 3. Submit Samples on rigid backing, 8 inches square.
 - a. Step coats on Samples to show each coat required for system.
 - b. Label each coat of each Sample.
 - c. Label each Sample for location and application area.
- 4. Product List: For each product indicated, include the following:
 - a. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - b. VOC content.
- B. Informational Submittals:
 - 1. Certifications specified in Quality Assurance article.
 - 2. Qualification Data: Applicator's qualification data.
 - 3. Manufacturer's instructions.
- C. Maintenance Materials Submittals
 - 1. Furnish two gallons of each type of paint used on the project.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Field Samples: Apply field samples of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on field samples.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of field samples does not constitute approval of deviations from the Contract Documents contained in field samples unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 MOCK-UPS

- A. Mock-ups: Apply mock-ups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

- b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mock-ups.
 - a. If preliminary color selections are not approved, apply additional mock-ups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.
- B. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
- 1. Add other requirements to suit Project.
 - 2. Product name or title of material.
 - 3. Product description (generic classification or binder type).
 - 4. Manufacturer's stock number and date of manufacture.
 - 5. Contents by volume, for pigment and vehicle constituents.
 - 6. Thinning instructions.
 - 7. Application instructions.
 - 8. Color name and number.
 - 9. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
- 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.08 FIELD CONDITIONS

- A. Environmental Conditions: Comply with more restrictive of following or manufacturer's requirements under which systems can be applied.
- 1. Provide illumination of not less than 80 footcandles measured mid-height at substrate surface during application of coatings.
 - 2. Apply water reducible coatings only when ambient and surface temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).
 - 3. Apply solvent reducible coatings only when ambient and surface temperatures are between 45 deg F (7 deg C) and 90 deg F (32 deg C).
 - 4. Do not apply coatings under any of following conditions:
 - a. When surfaces are damp or wet.
 - b. During rain, fog, or mist.
 - c. When relative humidity is less than 20 percent or exceeds 85 percent.
 - d. When temperature is less than 5 deg F (- 15 deg C) above dew point.
 - e. When dust may be generated before coatings have dried.
 - f. In direct sunlight.
 - g. When wind velocity is above 20 mph.
 - 5. Application of coatings may continue during inclement weather provided work areas and surfaces to be coated are enclosed and specified environmental conditions are maintained.

1.09 WARRANTY

- A. Warrant installation to be free from defects in material and workmanship for 5 years.
- B. Repair or replace defects occurring during warranty period.
- 1. Defects include but are not limited to pinholes, crazing or cracking, loss of adhesion to substrate, deficient thickness, improper materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturers:
 - 1. Benjamin Moore & Co .
 - 2. Behr Process Corporation.
 - 3. Dunn-Edwards Corporation.
 - 4. Kelly-Moore Paint Company Inc.
 - 5. PPG Paints.
 - 6. Sherwin-Williams Company (The).
 - 7. Tnemec.
 - 8. Vista Paint.

2.02 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Coatings:
 - 1. Ready-mixed, factory tinted, best professional grade produced by manufacturer.
 - 2. Use manufacturer's appropriate base materials to achieve required colors.
 - 3. Fully grind pigments to maintain soft paste consistency in vehicle.
 - 4. Capable of being dispersed into uniform, homogeneous mixture.
 - 5. Possess good flowing and brushing properties.
 - 6. Capable of drying or curing free of streaks or sags, and yielding specified finish.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet or not exceed the VOC (Volatile Organic Compounds) limits of the current requirements of Green Seal Standards GS-11 - Paints in the building, and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water
 - b. Flats: 50 grams per liter of product minus water
 - c. Non-flats: 100 grams per liter of product minus water
 - d. Non-flat High Gloss: 150 grams per liter of product minus water
 - e. Dry-Fog Coatings: 150 g/L.
 - f. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - g. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - h. Floor Coatings: 100 g/L.
 - i. Shellacs, Clear: 730 g/L.
 - j. Shellacs, Pigmented: 550 g/L.
- F. Colors: As selected by Architect from manufacturer's full range.

1. 30 percent of surface area will be painted with deep tones.

2.03 PRIMERS/SEALERS

- A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
 1. Basis of Design Product:
 - a. Cloverdale; ClovaClean
 - b. Krud Kutter; Metal Clean and Etch.
 - c. Great Lakes Laboratories; Clean'n Etch.

- B. Exterior Gypsum Soffit Board Primer: Factory-formulated alkyd- or alkali-resistant acrylic-latex primer for exterior application.
 1. Benjamin Moore and Company: Fresh Start All Purpose Alkyd Primer #204. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Premium Plus Int/Ext Multi-Surface Primer 436: Applied at minimum 1.7 mils DFT.
 3. Dunn-Edwards Corporation; UGPR00-1 Ultra-Grip Premium, Ultra-Low VOC, Interior / Exterior Acrylic Multi-Surface Primer: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 250 Color Shield Exterior Acrylic Primer. Applied at a dry film thickness of not less than 1.7 mils.
 5. PPG Paints; Seal Grip Acrylic Universal Primer 17-921XI. Applied at a dry film thickness of not less than 1.6 mils.
 6. Sherwin-Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series . Applied at a dry film thickness of not less than 1.4 mils.
 7. Tnemec; Series 180 W.B. Tneme-Crete. Applied at a dry film thickness rate of not less than 4.0 mils.
 8. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.

- C. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
 1. Benjamin Moore and Company: Super Spec HP Acrylic Metal Primer #P04. Applied at a dry film thickness of not less than 1.7 mil.
 2. Behr Premium Plus Int/Ext Multi-Surface Primer 436: Applied at minimum 1.7 mils DFT.
 3. Dunn-Edwards Corporation; BRPR00-1 Bloc-Rust Premium, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer: Applied at a dry film thickness of not less than 2.0 mils
 4. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
 5. PPG Paints; Speedhide Alkyd Metal Primer 6-208. Applied at a dry film thickness of not less than 2.3 mils or Water Based option; Pitt Tech Plus DTM Acrylic Primer 4020 Applied at a dry film thickness of not less than 2.0 mils.
 6. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ0006/B50WZ0001/B50AZ0006: Applied at a dry film thickness of not less than 3.2 mils.
 7. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66 1300 Series. Applied at a dry film thickness of not less than 2.0 mils.
 - 8.
 9. Tnemec; Series 115 Uni-Bond DF. Applied at a dry film thickness rate of not less than 3.0 mils DFT.
 10. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.

- D. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
 1. DeVoe (International): Devflex 4020 DTM Flat Interior / Exterior Waterborne Primer .
 2. Benjamin Moore and Company: Super Spec HP Acrylic Metal Primer #P04. Applied at a dry film thickness of not less than 1.7 mil.
 3. Behr Premium Plus Int/Ext Multi-Surface Primer 436: Applied at minimum 1.7 mils DFT.
 4. Dunn-Edwards Corporation; UGPR00-1 Ultra-Grip Premium, Ultra-Low VOC, Interior / Exterior Acrylic Multi-Surface Primer: Applied at a dry film thickness of not less than 1.5 mils.

5. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
 6. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils.
 7. PPG Paints; Pitt Tech Plus DTM Acrylic Primer 4020 Applied at a dry film thickness of not less than 2.0 mils.
 8. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66-1300 Series. Applied at a dry film thickness of not less than 2.0 mils.
 9. Tnemec:
 - a. Under Acrylics: Series 115 Uni-Bond DF; Applied at a dry film thickness rate of not less than 3.0 mils.
 - b. Under Urethane: Series L69 H.B. Epoxoline II; Applied at a dry film thickness rate of not less than 3.0 mils.
 10. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.
- E. Exterior Aluminum Primer under Acrylic Finishes: Factory-formulated acrylic-based metal primer for exterior application.
1. Benjamin Moore and Company: Super Spec HP Acrylic Metal Primer #P04. Applied at a dry film thickness of not less than 1.7 mil.
 2. Behr Premium Plus Int/Ext Multi-Surface Primer 436: Applied at minimum 1.7 mils DFT.
 3. Dunn-Edwards Corporation; UGPR00-1 Ultra-Grip Premium, Ultra-Low VOC, Interior / Exterior Acrylic Multi-Surface Primer: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
 5. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils.
 6. PPG Paints; Pitt Tech Plus DTM Acrylic Primer 4020 Applied at a dry film thickness of not less than 2.0 mils.
 7. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66-13300. Applied at a dry film thickness of not less than 2.0 mils.
 8. Tnemec; Series 115 Uni-Bond DF; Applied at a dry film thickness rate of not less than 3.0 mils.
 9. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.

2.04 WATER-BASED PAINTS

- A. Exterior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for exterior application.
1. Benjamin Moore and Company: Ultra Spec EXT Flat Finish N447. Applied at a dry film thickness of not less than 1.5 mil.
 2. Behr Pro Exterior Flat Paint PR610: Applied at minimum 1.36 mils DFT.
 3. Dunn-Edwards Corporation; SSSL10 Spartashield Exterior, Ultra-Low VOC, 100% Acrylic Exterior Flat Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1205 Color Shield Exterior Flat Acrylic House Paint: Applied at a dry film thickness of not less than 1.9 mils.
 5. PPG Paints; Speedhide Exterior 100% Acrylic Flat Latex 6-610XI Series. Applied at a dry film thickness of not less than 1.5 mils.
 6. Sherwin-Williams; A-100 Exterior Latex Flat A6 Series: Applied at a dry film thickness of not less than 1.3 mils.
 7. Tnemec; Series 180 W.B. Tneme-Crete; Applied at a dry film thickness rate of not less than 4.0 mils.
 8. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.
- B. Exterior Low-Luster Acrylic Paint: Factory-formulated low-sheen (eggshell) acrylic-latex paint for exterior application.
1. Benjamin Moore and Company: Ultra Spec EXT Satin Finish N448. Applied at a dry film thickness of not less than 1.5 mil.

2. Behr Premium Plus Exterior Satin Enamel 9050: Applied at minimum 1.5 mils DFT.
 3. Dunn-Edwards Corporation; SSSL40 Spartashield Exterior, Ultra-Low VOC, 100% Acrylic Low Sheen Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1245 Acry-Velvet Exterior Low Sheen Acrylic Finish: Applied at a dry film thickness of not less than 1.8 mils.
 5. PPG Paints; Speedhide Exterior 100% Acrylic Satin Latex 6-2045XI Series. Applied at a dry film thickness of not less than 1.5 mils.
 6. Sherwin-Williams; A-100 Exterior Latex Satin A82 Series: Applied at a dry film thickness of not less than 1.5 mils.
 7. Tnemec; Series 1029 Enduratone; Applied at a dry film thickness rate of not less than 2.0 mils.
 8. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.
- C. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
1. Benjamin Moore and Company: Ultra Spec EXT Gloss Finish N449. Applied at a dry film thickness of not less than 1.5 mil.
 2. Behr Premium Plus Exterior Semi-Gloss Enamel 5050: Applied at minimum 1.5 mils DFT.
 3. Dunn-Edwards Corporation; SSSL50 Spartashield Exterior, Ultra-Low, 100% Acrylic Semi-Gloss Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1250 Acry-Lustre Exterior Semi-Gloss Acrylic Finish: Applied at a dry film thickness of not less than 1.6 mils.
 5. PPG Paints; Speedhide Exterior 100% Acrylic Semi-Gloss Latex 6-900XI Series. Applied at a dry film thickness of not less than 1.5 mils.
 6. Sherwin-Williams; A-100 Latex Gloss A8 Series: Applied at a dry film thickness of not less than 1.3 mils.
 7. Tnemec; Series 1029 Enduratone; Applied at a dry film thickness rate of not less than 2.0 mils.
 8. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.
- D. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
1. Benjamin Moore and Company: Ultra Spec EXT Gloss Finish N449. Applied at a dry film thickness of not less than 1.5 mil.
 2. Behr Premium Plus Int/Ext Hi-Gloss Enamel 2-8050: Apply at minimum 1.5 mils DFT.
 3. Dunn-Edwards Corporation; SSSL60 Spartashield Interior and Exterior, Ultra-Low, 100% Acrylic Gloss Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 5780 DTM Acrylic Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
 5. PPG Paints; Pitt Tech DTM Acrylic Gloss 90-374 Series. Applied at a dry film thickness of not less than 2.0 mils.
 6. Sherwin-Williams; S-W Pro Industrial Acrylic Gloss, B66-600 Series. Applied at a dry film thickness of not less than 2.1 mils.
 7. Tnemec; Series 1028 Enduratone; Applied at a dry film thickness rate of not less than 2.0.
 8. Vista Paint Corporation: 4600 Uniprime II at a dry film thickness of not less than 2.0 mil.

2.05 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected

materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
 - 2. Cement Plaster Substrates: Verify that plaster is fully cured.
 - 3. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
- D. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- E. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- G. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."

- 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- H. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- I. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- J. Aluminum Substrates: Remove loose surface oxidation.
- K. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- L. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
- B. Use applicators and techniques suited for paint and substrate indicated.
- C. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- D. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
- E. Paint entire exposed surface of window frames and sashes.
- F. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- G. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- H. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- I. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- J. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- K. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
- L. Paint the following work where exposed to view:
- M. Equipment, including panelboards .
- N. Uninsulated metal piping.

- O. Uninsulated plastic piping.
- P. Pipe hangers and supports.
- Q. Metal conduit.
- R. Plastic conduit.
- S. Tanks that do not have factory-applied final finishes.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 - 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, exterior, sheen as indicated on Finish Schedule.
- B. Galvanized-Metal Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, sheen as indicated on Finish Schedule.
- C. Aluminum Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer, quick dry, for aluminum.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior gloss - sheen as indicated on Finish Schedule.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL**1.01 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on interior substrates.
- B. Surface preparation and field painting of exposed items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - 2. Field finish coating of shop or factory primed and prefinished items. Refer to individual Sections for priming requirements.
 - 3. Finish coatings schedule.
 - 4. Preparation work and coatings specified in this Section are in addition to shop and factory applied finishes and surface treatment specified in other Sections.
 - 5. Paint all other items unless specifically indicated not to be painted.
 - 6. Color schedule.
- C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

1.02 DEFINITIONS

- A. Conform to PDCA Glossary for interpretation of terms used in this Section except as modified below.
- B. Exposed Surfaces: Surfaces of products, assemblies, and components visible from any angle after final installation. Includes internal surfaces visible when operable doors, panels or drawers are open, and surfaces visible behind registers, grilles, or louvers.
- C. Concealed Surfaces: Surfaces permanently hidden from view in finished construction and which are only visible after removal or disassembly of part or all of product or assembly.
- D. Inaccessible Spaces: Spaces not intended for human use.
 - 1. Standard terms used by the coatings industry are defined in ASTM D16.
- E. Gloss Levels according to ASTM D523:
 - 1. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees.
 - 2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 3. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 4. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
 - 5. Gloss Level 5: 35 to 70 units at 60 degrees.
 - 6. Gloss Level 6: 70 to 85 units at 60 degrees.
 - 7. Gloss Level 7: More than 85 units at 60 degrees.
- F. System DFT: Dry film thickness of entire coating system unless otherwise noted.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.

- C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
- D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
- E. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- F. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; 2016.
- G. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; 2015.
- H. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- I. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).
- J. SSPC-SP 3 - Power Tool Cleaning; 1982, with Editorial Revision (2004).
- K. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- L. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each paint system indicated. Include block fillers and primers.
 - a. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - b. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - 2. Samples for Initial Selection: For each type of topcoat product.
 - 3. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - a. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - b. Step coats on Samples to show each coat required for system.
 - c. Label each coat of each Sample.
 - d. Label each Sample for location and application area.
 - 4. Product List: For each product indicated, include the following:
 - a. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - b. VOC content.
- B. Informational Submittals:
 - 1. Certifications specified in Quality Assurance article.
 - 2. Qualification Data: Applicator's qualification data.
 - 3. Manufacturer's instructions.
- C. Maintenance Materials Submittals:
 - 1. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 2. Furnish two gallons of each type of paint used on the project.

1.05 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:

1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.06 MOCK-UPS

- A. Mock-ups: Apply mock-ups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mock-ups.
 - a. If preliminary color selections are not approved, apply additional mock-ups of additional colors selected by Architect at no added cost to Owner.
 3. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 1. Add other requirements to suit Project.
 2. Product name or title of material.
 3. Product description (generic classification or binder type).
 4. Manufacturer's stock number and date of manufacture.
 5. Contents by volume, for pigment and vehicle constituents.
 6. Thinning instructions.
 7. Application instructions.
 8. Color name and number.
 9. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.08 FIELD CONDITIONS

- A. Environmental Conditions: Comply with more restrictive of following or manufacturer's requirements under which systems can be applied.
 1. Provide continuous ventilation during application of coatings to exhaust hazardous fumes.
 2. Provide heating necessary to maintain surface and ambient temperatures within specified limits.
 3. Maintain temperature and humidity conditions for minimum 24 hours before, during, and 48 hours after application of finishes, unless longer times are required by manufacturer.
 4. Do not permit wide variations in ambient temperatures which might result in condensation on freshly coated surfaces.
 5. Provide illumination of not less than 80 footcandles measured mid-height at substrate surface during application of coatings.
 6. Apply water reducible coatings only when ambient and surface temperatures are between 50 degrees F and 90 degrees F.
 7. Apply solvent reducible coatings only when ambient and surface temperatures are between 45 degrees F and 90 degrees F.

8. Do not apply coatings under any of following conditions:
 - a. When surfaces are damp or wet.
 - b. During snow, rain, fog, or mist.
 - c. When relative humidity is less than 20 percent or exceeds 85 percent.
 - d. When temperature is less than 5 degrees F above dew point.
 - e. When dust may be generated before coatings have dried.
 - f. In direct sunlight.
 - g. When wind velocity is above 20 mph.
9. Application of coatings may continue during inclement weather provided work areas and surfaces to be coated are enclosed and specified environmental conditions are maintained.

1.09 WARRANTY

- A. Warrant installation to be free from defects in material and workmanship for 5 years.
- B. Repair or replace defects occurring during warranty period.
 1. Defects include but are not limited to pinholes, crazing or cracking, loss of adhesion to substrate, deficient thickness, improper materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturers:
 1. Benjamin Moore & Co.
 2. Behr Process Corporation
 3. Dunn-Edwards Corporation.
 4. Kelly-Moore Paint Company Inc.
 5. PPG Paints.
 6. Sherwin-Williams Company (The).
 7. Vista Paint.

2.02 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Coatings:
 1. Ready-mixed, factory tinted, best professional grade produced by manufacturer.
 2. Use manufacturer's appropriate base materials to achieve required colors.
 3. Fully grind pigments to maintain soft paste consistency in vehicle.
 4. Capable of being dispersed into uniform, homogeneous mixture.
 5. Possess good flowing and brushing properties.
 6. Capable of drying or curing free of streaks or sags, and yielding specified finish.
 7. VOC content of field applied coatings shall comply with local governing authorities.
- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 1. Flat Paints and Coatings: 50 g/L.

2. Nonflat Paints and Coatings: 150 g/L.
 3. Dry-Fog Coatings: 400 g/L.
 4. Primers, Sealers, and Undercoaters: 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coatings: 100 g/L.
 9. Shellacs, Clear: 730 g/L.
 10. Shellacs, Pigmented: 550 g/L.
- E. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- F. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet or not exceed the VOC (Volatile Organic Compounds) limits of the current requirements of Green Seal Standards GS-11 - Paints in the building, and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
1. CAL-Green requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water
 - b. Flats: 50 grams per liter of product minus water
 - c. Non-flats: 100 grams per liter of product minus water
 - d. Non-flat High Gloss: 150 grams per liter of product minus water
 - e. Dry-Fog Coatings: 150 g/L.
 - f. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - g. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - h. Floor Coatings: 100 g/L.
 - i. Shellacs, Clear: 730 g/L.
 - j. Shellacs, Pigmented: 550 g/L.
- G. Colors: As indicated in a color schedule.

2.03 BLOCK FILLERS

- A. Interior Concrete Block Filler: Factory-formulated interior and exterior concrete block filler. PDCA Level 2.
1. Benjamin Moore and Company: Super Spec Masonry Int/Ext HI-Build Block Filler 206. Applied at a dry film thickness of not less than 8.5 mil.
 2. Behr Pro Block Filler Primer PR50: Applied at minimum 5.4 mils DFT.
 3. Dunn-Edwards Corporation; SBSL00 Smooth Bloctil Select, Interior / Exterior Concrete Block Filler:
 4. PPG Industries; Speedhide Interior Exterior Latex Block Filler 6-7
 5. Sherwin-Williams: Prep-Rite Block Filler B25W25. Applied at a dry film thickness of not less than 7.7 mil.
 6. Vista Paint Corporation: 040 Block Kote Applied at a dry film thickness of not less than 8.4 mil.

2.04 PRIMERS/SEALERS

- A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
1. Basis of Design Product:
 - a. Cloverdale; ClovaClean
 - b. Krud Kutter; Metal Clean and Etch.
 - c. Great Lakes Laboratories; Clean'n Etch.
- B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. Benjamin Moore and Company: Ultra Spec 500 Interior Latex Primer #N534. Applied at a dry film thickness of not less than 1.8 mil.

2. Behr Pro Interior PVA Drywall Primer PR10: Applied at minimum 1.0 mils DFT.
 3. Dunn-Edwards Corporation; VNLSL00-1 Vinylastic Select Low Odor / Zero VOC Interior Wall Sealer: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 971 Acry-Prime Interior Latex Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils.
 5. PPG Paints; Speedhide zero Interior Latex Primer/Sealer 6-4900XI. Applied at a dry film thickness of not less than 1.4 mils
 6. Sherwin-Williams; S-W ProMar 200 Zero VOC Primer, B28W02600. Applied at a dry film thickness of not less than 1.0 mil.
 7. Vista Paint Corporation: 5001 V-Pro Zero VOC Primer Applied at a dry film thickness of not less than 1.2 mil.
- C. Interior Wood Primer for Acrylic-Enamel and Semigloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
1. Benjamin Moore and Company: Ultra Spec 500 Interior Latex Primer #N534. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Premium Plus All-In-One Primer & Sealer 75: Applied at minimum 1.6 mils DFT.
 3. Dunn-Edwards Corporation; Dunn-Edwards Corporation; IKPR00-1 Inter-Kote Premium Low Odor / Zero VOC Interior Undercoater: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 975 Acry Plex Interior Latex Enamel Undercoat: Applied at a dry film thickness of not less than 1.6 mils.
 5. PPG Paints; Seal Grip Interior Primer/Finis 17-951. Applied at a dry film thickness of not less than 1.2 mils
 6. Sherwin-Williams; Premium Wall and Wood Primer B28W08111 Series: Applied at a dry film thickness of not less than 1.6 mils.
 7. Sherwin-Williams; S-W PrepRite ProBlock Latex Primer/Sealer B51-600 Series. Applied at a dry film thickness of not less than 1.4 mil.
 8. Sherwin-Williams; ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC, MPI-149. Applied at a dry film thickness of not less than 1.0 mil.
 9. Vista Paint Corporation: 5001 V-Pro Zero VOC Primer Applied at a dry film thickness of not less than 1.2 mil.
- D. Interior Wood Primer for Full-Gloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
1. Benjamin Moore and Company: Ultra Spec 500 Interior Latex Primer #N534 Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Premium Plus All-In-One Primer & Sealer 75: Applied at minimum 1.6 mils DFT.
 3. Dunn-Edwards Corporation; IKPR00-1 Inter-Kote Premium Low Odor / Zero VOC Interior Undercoater: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 985 Flo-Cote Alkyd Enamel Undercoater: Applied at a dry film thickness of not less than 2.5 mils.
 5. PPG Paints; Seal Grip Interior Primer/Finis 17-951. Applied at a dry film thickness of not less than 1.2 mils.
 6. Sherwin-Williams; S-W PrepRite ProBlock Latex Primer/Sealer B51-600 Series. Applied at a dry film thickness of not less than 1.4 mil.
 7. Vista Paint Corporation: 4200 Terminator II Applied at a dry film thickness of not less than 1.9 mil.
- E. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
1. Benjamin Moore and Company: Super Spec HP Alkyd Metal Primer #P06. Applied at a dry film thickness of not less than 1.7 mil.
 2. Behr Premium Plus Int/Ext Multi-Surface Primer & Sealer 436: Applied at minimum 1.7 mils DFT.

3. Dunn-Edwards Corporation; BRPR00-1 Bloc-Rust Premium, Ultra Low VOC, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer: Applied at a dry film thickness of not less than 2.0 mils.
 4. Dunn-Edwards Corporation; ULDM00 Ultrashield, Low Odor / Zero VOC, Interior / Exterior DTM Gray Primer: Applied at a dry film thickness of not less than 2.0 mils.
 5. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
 6. PPG Paints; Pitt Tech Plus DTM Acrylic Primer 4020. Applied at a dry film thickness of not less than 2.0 mils.
 7. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66W310. Applied at a dry film thickness of not less than 3.0 mils.
 8. Vista Paint Corporation: 9600 Protec Metal Primer. Applied at a dry film thickness of not less than 2.0 mil.
- F. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
1. Benjamin Moore and Company: Super Spec HP Acrylic Metal Primer #P04. Applied at a dry film thickness of not less than 1.7 mils.
 2. Behr Premium Plus Int/Ext Multi-Surface Primer & Sealer 436: Applied at minimum 1.7 mils DFT.
 3. Dunn-Edwards Corporation; UGSL00-1 Ultra-Grip Select, Low Odor / Zero VOC, Interior / Exterior Acrylic Multi-Surface Primer: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
 5. PPG Paints; Pitt Tech Plus DTM Acrylic Primer 4020. Applied at a dry film thickness of not less than 2.0 mils
 6. Sherwin-Williams: DTM Wash Primer, B71Y00001. Applied at a dry film thickness of not less than 7.0 mils.
 7. Sherwin-Williams; Pro Industrial Pro-Cryl Primer B66-1300 series. Applied at a dry film thickness of not less than 2.0 mils
 8. Vista Paint Corporation: 4800 Metal Pro Primer Applied at a dry film thickness of not less than 1.2 mil.
- G. Interior Ferrous-Metal Primer for High Performance Paint: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
1. Benjamin Moore and Company: Super Spec HP Alkyd Metal Primer #P06. Applied at a dry film thickness of not less than 1.7 mil.
 2. Behr Premium Plus Int/Ext Multi-Surface Primer & Sealer 436: Applied at minimum 1.7 mils DFT.
 3. Dunn-Edwards Corporation; ENPR00 Enduraprime Low VOC, Interior / Exterior, Red Oxide or White, Waterborne Alkyd Rust Preventative Metal Primer: Applied at a dry film thickness of not less than 2.0 mils.
 4. Dunn-Edwards Corporation; ULDM00 Ultrashield, Low Odor / Zero VOC, Interior / Exterior DTM Gray Primer: Applied at a dry film thickness of not less than 2.0 mils.
 5. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
 6. PPG Paints; Pitt Tech Plus DTM Acrylic Primer 4020. Applied at a dry film thickness of not less than 2.0 mils.
 7. Sherwin-Williams; S-W Pro Industrial ProCryl Universal Acrylic Primer, B66-1300 Series. Applied at a dry film thickness of not less than 2.0 mils.
 8. Vista Paint Corporation: 9600 Protec Metal Primer. Applied at a dry film thickness of not less than 2.0 mil.
- H. Interior Zinc-Coated Metal Primer for High Performance Paint: Factory-formulated galvanized metal primer.
1. Benjamin Moore and Company: Super Spec HP Acrylic Metal Primer #P04. Applied at a dry film thickness of not less than 1.7 mils.

2. Behr Premium Plus Int/Ext Multi-Surface Primer & Sealer 436: Applied at minimum 1.7 mils DFT.
3. Dunn-Edwards Corporation; ULGM00-WH Ultrasheid Interior/Exterior Galvanized Metal Primer, Low VOC: Applied at a dry film thickness of not less than 2.0 mils.
4. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
5. PPG Paints; Pitt Tech Plus DTM Acrylic Primer 4020. Applied at a dry film thickness of not less than 2.0 mils
6. Sherwin-Williams: DTM Wash Primer, B71Y00001. Applied at a dry film thickness of not less than 7.0 mils.
7. Sherwin-Williams; Pro Industrial Pro-Cryl Primer B66-1300 Series. Applied at a dry film thickness of not less than 2.0 mils
8. Vista Paint Corporation: 4800 Metal Pro Primer Applied at a dry film thickness of not less than 1.2 mil.

2.05 FINISH COATS

- A. High-Performance Architectural Latex System - Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
 1. Benjamin Moore and Company: Ultra Spec 500 Interior Flat Finish N536. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Pro Interior Dead Flat Paint PR310: Applied at minimum 1.65 mils DFT.
 3. Dunn-Edwards Corporation; SZRO10 Spartazero Low Odor / Zero VOC Interior Flat Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 450 Pro-Wall Interior Flat Latex Wall Paint: Applied at a dry film thickness of not less than 1.8 mils.
 5. PPG Paints; Speedhide zero Interior Latex Flat 6-4110XI. Applied at a dry film thickness of not less than 1.3 mils
 6. Sherwin-Williams; S-W ProMar 200 Zero VOC Flat, B30W02651. Applied at a dry film thickness of not less than 1.6 mil.
 7. Vista Paint Corporation: 5100 V-Pro Flat Applied at a dry film thickness of not less than 1.8 mil.

- B. High-Performance Architectural Latex System - Flat Latex-Emulsion Size: Factory-formulated flat latex-based interior paint.
 1. Benjamin Moore and Company: Ultra Spec 500 Interior Flat Finish N536. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Pro Interior Dead Flat Paint PR310: Applied at minimum 1.65 mils DFT
 3. Dunn-Edwards Corporation; SZRO10 Spartazero Low Odor / Zero VOC Interior Flat Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 450 Pro-Wall Interior Flat Latex Wall Paint: Applied at a dry film thickness of not less than 1.8 mils.
 5. PPG Industries; Speedhide zero Interior Latex Flat 6-4110XI. Applied at a dry film thickness of not less than 1.3 mils
 6. Sherwin-Williams; S-W ProMar 200 Zero VOC Flat, B30W02651. Applied at a dry film thickness of not less than 1.6 mil.
 7. Vista Paint Corporation: 5100 V-Pro Flat Applied at a dry film thickness of not less than 1.8 mil.

- C. High-Performance Architectural Latex System - Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
 1. Benjamin Moore and Company: Ultra Spec 500 Interior Eggshell Finish N538. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Pro Interior Eggshell Paint PR330; Applied at minimum 1.45 mils DFT.
 3. Dunn-Edwards Corporation; SZRO20 Spartazero Low Odor / Zero VOC Interior Velvet Paint: Applied at a dry film thickness of not less than 1.5 mils.

4. Dunn-Edwards Corporation; SZRO30 Spartazero Low Odor / Zero VOC Interior Eggshell Paint: Applied at a dry film thickness of not less than 1.5 mils.
 5. Kelly-Moore; 1610 Sat-N-Sheen Interior Latex Low Sheen Wall and Trim Finish: Applied at a dry film thickness of not less than 1.6 mils.
 6. PPG Paints; Speedhide zero Interior Latex Eggshell 6-4310XI. Applied at a dry film thickness of not less than 1.5 mils
 7. Sherwin-Williams; S-W ProMar 200 Zero VOC EgShel, B20W02651. Applied at a dry film thickness of not less than 1.6 mil.
 8. Vista Paint Corporation: 5300 V-Pro Eggshell Applied at a dry film thickness of not less than 1.8 mil.
- D. High-Performance Architectural Latex System - Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
1. Benjamin Moore and Company: Ultra Spec 500 Interior Semi-Gloss Finish N539. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Pro Interior Semi-Gloss Paint PR370; Applied at minimum 1.45 mils DFT.
 3. Dunn-Edwards Corporation; SZRO50 Spartazero Low Odor / Zero VOC Interior Semi-Gloss Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1649 Acrylic-Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
 5. PPG Paints; Speedhide zero Interior Latex Semi-Gloss 6-4510XI. Applied at a dry film thickness of not less than 1.3 mils
 6. Sherwin-Williams; ProMar 200 Zero VOC Sem-Gloss, B31W02651. Applied at a dry film thickness of not less than 1.5 mil.
 7. Vista Paint Corporation: 5400 V-Pro Semi Gloss Applied at a dry film thickness of not less than 1.8 mil.
- E. High-Performance Architectural Latex System - Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel.
1. Benjamin Moore and Company: Ultra Spec 500 Interior Gloss Finish N540. Applied at a dry film thickness of not less than 1.8 mil.
 2. Behr Premium Plus Int/Ext Hi-Gloss Enamel 2-8050: Applied at minimum 1.4 mils DFT.
 3. Dunn-Edwards Corporation; (ULSH60) Ultrashield Low Odor / Zero VOC Interior / Exterior Gloss Paint: Applied at a dry film thickness of not less than 2.0 mils.
 4. Kelly-Moore; 1680 Dura-Poxy Gloss Acrylic Enamel: Applied at a dry film thickness of not less than 1.6 mils.
 5. PPG Paints; 6-8534 SpeedHide Interior Latex 100 Percent Acrylic Gloss Enamels: Applied at a dry film thickness of not less than 1.2 mil.
 6. Sherwin-Williams; Solo 100% Acrylic Interior/Exterior Gloss: Applied at a dry film thickness of not less than 1.5 mils.
 7. Vista Paint Corporation: 7600 Coverall Gloss Applied at a dry film thickness of not less than 1.3 mil.
- F. Interior Semigloss Alkyd Enamel: Factory-formulated semigloss alkyd enamel for interior application.
1. Benjamin Moore and Company: Advance Waterborne Interior Waterborne Interior Alkyd Satin Finish #792. Applied at a dry film thickness of not less than 1.35 mil.
 2. Behr Premium Int/Ext Alkyd Semi-Gloss Enamel 3900: Applied at minimum 1.3 mils DFT.
 3. Dunn-Edwards Corporation; AWLL50 Aristowall, Ultra-Low VOC, Interior, Waterborne Alkyd, Semi-Gloss Paint: Applied at a dry film thickness of not less than 1.5 mils.
 4. Kelly-Moore; 1630--Kel-Cote Interior Alkyd Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.2 mils.
 5. PPG Paints; Interior Alkyd 4139 Series. Applied at a dry film thickness of not less than 2.0 mils
 6. Sherwin-Williams; Pro Industrial Waterbased Alkyd Urethane Enamel, B53-1150 Series. Applied at a dry film thickness of not less than 1.4 mils.

7. Sherwin-Williams; ProMar 200 Interior Alkyd Semi-Gloss, B34-00250 series. Applied at a dry film thickness of not less than 1.7 mils.
 8. Vista Paint Corporation: XXXX Applied at a dry film thickness of not less than x.x mil.
- G. Interior Full-Gloss Alkyd Enamel for Gypsum Board and Plaster: Factory-formulated full-gloss alkyd interior enamel.
1. Benjamin Moore and Company: Advance Waterborne Interior Waterborne Interior/Exterior Alkyd High Gloss Finish #794. Applied at a dry film thickness of not less than 1.5 mil.
 2. Dunn-Edwards Corporation; AWLL60 Aristowall, Ultra-Low VOC, Interior, Waterborne Alkyd, Gloss Paint. Apply at a dry film thickness of not less than 1.5 mils.
 3. Kelly-Moore; 1700 Kel-Guard Gloss Alkyd Rust Inhibitive Enamel: Applied at a dry film thickness of not less than 2.0 mils.
 4. PPG Paints; Interior Alkyd 4139 Series. Applied at a dry film thickness of not less than 2.0 mils
 5. Sherwin-Williams; Pro Industrial Waterbased Alkyd Urethane Enamel, B53-1050 Series. Applied at a dry film thickness of not less than 1.4 mils.
 6. Sherwin-Williams; ProMar 200 Interior Alkyd Gloss, B35W00251. Applied at a dry film thickness of not less than 1.5 mils.
 7. Vista Paint Corporation: 9500 Aqua Fusion Gloss Applied at a dry film thickness of not less than 2.0 mil.
- H. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.
1. Benjamin Moore and Company: Advance Waterborne Interior Waterborne Interior Alkyd Satin Finish #792. Applied at a dry film thickness of not less than 1.35 mil.
 2. Dunn-Edwards Corporation; AWLL60 Aristowall, Ultra-Low VOC, Interior, Waterborne Alkyd, Gloss Paint. Apply at a dry film thickness of not less than 1.5 mils.
 3. Kelly-Moore; 1630--Kel-Cote Interior Alkyd Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.3 mils.
 4. PPG Paints; Interior Alkyd 4139 Series. Applied at a dry film thickness of not less than 2.0 mils
 5. Sherwin-Williams; Pro Industrial Waterbased Alkyd Urethane Enamel, B53-1050 Series. Applied at a dry film thickness of not less than 1.4 mils.
 6. Sherwin-Williams; ProMar 200 Interior Alkyd Gloss, B35W00251. Applied at a dry film thickness of not less than 1.5 mils.
 7. Vista Paint Corporation: 9500 Aqua Fusion Gloss Applied at a dry film thickness of not less than 2.0 mil.

2.06 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.

AE3 Partners

DSA Application No. 01-119166
September 7, 2021

Increment 1
09 9123 - 10

Merritt College
Child Development Center
INTERIOR PAINTING

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Masonry (Clay and CMU): 12 percent.
 3. Wood: 15 percent.
 4. Gypsum Board: 12 percent.
 5. Plaster: 12 percent.
- D. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- E. Plaster Substrates: Verify that plaster is fully cured.
- F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods or chemical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
 6. Paint Color Transitions: Provide sharp straight line transitions from colors with no bleed.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 INTERIOR PAINTING SCHEDULE

- A. Sheen: Sheen as indicated on Finish Schedule.
- B. Steel Substrates:
 - 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, sheen as indicated on Finish Schedule.
 - 2. High-Performance Steel System for Hangar Areas:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: High performance acrylic architectural paint, matching topcoat.
 - c. Topcoat: High performance acrylic architectural paint, gloss (Gloss Level 6).
- C. Galvanized-Metal Substrates:
 - 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, galvanized, water based.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, sheen as indicated on Finish Schedule.
- D. Wood Substrates: Including wood trim, architectural woodwork, doors, windows, and wood-based panel products
 - 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, sheen as indicated on Finish Schedule.
- E. Gypsum Board Substrates:
 - 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. Topcoat: Latex, interior, sheen as indicated on Finish Schedule.

END OF SECTION

**SECTION 09 9600
HIGH-PERFORMANCE COATINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High performance coatings.
- B. Surface preparation.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide complete list of all products to be used, with the following information for each:
 - a. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - b. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
 - c. Manufacturer's installation instructions.
 - 2. Product Data: Provide data indicating coating materials .
 - 3. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors and coating systems in project for approval prior to construction of mockup.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 2. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
 - 3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 4. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
 - 5. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
 - 6. Maintenance Data: Include cleaning procedures and repair and patching techniques.
- C. Closeout Submittals:
 - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. Refer to Section 01 6000 - Product Requirements, for additional provisions.
 - b. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
 - c. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.03 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.04 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document that applies to application on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this Section with minimum three years documented experience.

1.05 MOCK-UPS

- A. Mock-ups: Apply mock-ups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mock-ups.
 - 3. Approval of mock-ups does not constitute approval of deviations from Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not apply coatings when relative humidity is outside the humidity ranges required by the coating product manufacturer.
- C. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).
- D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.
- F. Restrict traffic from area where coating is being applied or is curing.

1.08 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality coating material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated.

Coating-material containers not displaying manufacturer's product identification will not be acceptable.

- C. Coatings:
 - 1. Ready-mixed, factory tinted, best professional grade produced by manufacturer.
 - 2. Use manufacturer's appropriate base materials to achieve required colors.
 - 3. Fully grind pigments to maintain soft paste consistency in vehicle.
 - 4. Capable of being dispersed into uniform, homogeneous mixture.
 - 5. Possess good flowing and brushing properties.
 - 6. Capable of drying or curing free of streaks or sags, and yielding specified finish.
 - 7. VOC content of field applied coatings shall comply with local governing authorities.

- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
 - 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 6. Pretreatment Wash Primers: 420 g/L.

- E. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet or not exceed the VOC (Volatile Organic Compounds) limits of the current requirements of Green Seal Standards GS-11 - Paints in the building, and Cal-GREEN Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-GREEN Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water
 - b. Flats: 50 grams per liter of product minus water
 - c. Non-flats: 100 grams per liter of product minus water
 - d. Non-flat High Gloss: 150 grams per liter of product minus water
 - e. Dry-Fog Coatings: 150 g/L.
 - f. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - g. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - h. Floor Coatings: 100 g/L.
 - i. Shellacs, Clear: 730 g/L.
 - j. Shellacs, Pigmented: 550 g/L.

- F. Colors: As selected by Architect from manufacturer's full range.
 - 1. 10 percent of surface area will be painted with deep tones.

2.02 HIGH-PERFORMANCE COATINGS

- A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.

2.03 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

- B. Fluoropolymer: Two part thermoset solution fluoropolymer.
 - 1. Locations: Exterior steel and as indicated on Drawings.
 - 2. Basis of Design Product:
 - a. Tnemec Company, Inc., Fluoronar Series 1071V, 3.0 mils total dry film thickness.
 - b. Prior approved equal.

- C. Urethane Coating: Low VOC, aliphatic acrylic polyurethane coating apply 2.0 to 4.0 mils DFT.
 - 1. Topcoat:
 - a. Number of Coats: One.
 - b. Basis of Design Product:
 - 1) Dunn-Edwards; Carboline Company: Carbothane 134 WB. Applied at a dry film thickness of not less than 2.0 to 2.5 mils.
 - 2) Approved equal.

2.04 INTERMEDIATE COATINGS

- A. Intermediate Epoxy Coating: Polyamidoamine epoxy coating.
 - 1. Basis of Design Product:
 - a. Carboline Company; Carboguard 1340. Applied at a dry film thickness of not less than 1 to 2 mils.

2.05 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer:
 - 1. Steel Primer: Polyamidoamine epoxy coating.
 - a. Basis of Design Products:
 - 1) Dunn-Edwards; Carboline, Rustbond.
 - 2. Block Fillers:
 - a. Waterborne acrylic block filler.
 - b. Basis of Design Product:
 - 1) Dunn-Edwards; Carboline Company: Sanitile 100. Applied at a dry film thickness of not less than 6.0 to 12.0 mils.

2.06 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.
- B. Cleaners:
 - 1. General: Mildewcide, TSP (tri-sodium phosphate), acidic-detergent, zinc sulfate, sodium metasilicate, and solvents:
 - 2. Commercially available.
 - 3. Non-damaging to surface being cleaned
 - 4. Complying with PDCA Specification Manual.
 - 5. Acceptable to coating manufacturer.
- C. Metal Conditioner: Proprietary phosphoric acid based, etching type solution; acceptable to coating manufacturer.
- D. Rust Inhibitor:
 - 1. Water containing 0.32 percent by weight of sodium nitrite and 1.28 percent by weight of secondary ammonium phosphate (dibasic).
 - 2. Water containing 0.2 percent by weight of chromic acid, sodium chromate, sodium dichromate, or potassium dichromate.
- E. Spackling compound, putty, fillers, liquid de-glosser, patching plaster, thinners, and materials not indicated but required to achieve finishes. Compatible with coating system and acceptable to coating manufacturer.
- F. Do not use products of different manufacturers in combination, unless approved by each manufacturer of products involved.

2.07 MIXING

- A. Use factory prepared colors matching approved samples. Site tinting will not be permitted.

- B. Thoroughly mix and stir coating components before use to ensure homogeneous dispersion of ingredients. Prior to application, blend multiple containers of same material and color by pouring from one container to another several times to ensure uniform consistency, color, and smoothness.
- C. Mix in clean pails of material recommended by manufacturer to avoid contamination.
- D. Mix only enough of multi-part coatings to allow application within pot life of mixture.
- E. Remove film which may form on surface of material in containers and strain material before using. Stir frequently during use to maintain pigments in suspension. Do not stir film into material.
- F. Apply coatings of consistency instructed by manufacturer.
- G. Thinning:
 1. Provide thinners approved by coating manufacturer.
 2. Add thinners within manufacturer recommended limits.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- F. Test shop-applied primer for compatibility with subsequent cover materials.
- G. Proceed with coating application only after unacceptable conditions have been corrected.
 1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Protect completed construction from damage. Furnish drop cloths, shields, and protective methods to prevent spray, splatter or droppings from disfiguring other surfaces.
- B. Remove surface hardware, mechanical diffusers, escutcheons, registers, electrical plates, light fixture trim, fittings, fastenings and similar items prior to preparing surfaces for finishing. Provide surface-applied protective masking for non-removable items. Carefully store removed items for reinstallation.
- C. Remove mildew by scrubbing with mildewcide. Rinse thoroughly with clean water.
- D. Before beginning application of coatings, ensure surfaces are clean, dry, and free of dirt, dust, rust, and rust scale, oil, grease, mold, mildew, algae, efflorescence, release agents and other harmful materials which could adversely affect coating adhesion and finished appearance.
- E. Clean surfaces of loose foreign matter.
- F. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- G. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- H. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 2. Prepare surface as recommended by coating manufacturer.
 - a. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi (690 to 4140 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
- I. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
 2. Prepare surfaces to be primed in accordance with SSPC-SP 3
- J. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

- A. General:
1. Coat surfaces specified, scheduled, illustrated, and otherwise identified unless specifically noted otherwise.
 2. Apply coatings of type, color, and sheen as scheduled.
 3. Apply products in accordance with manufacturer's instructions. Use application materials, equipment, and techniques as instructed by coating manufacturer and best suited for substrate and type of material being applied.
 4. Do not apply finishes to surfaces that are improperly prepared.
 5. Quantity of coats specified are minimum quantify acceptable.
 6. Apply coating systems to achieve scheduled total dry film thickness.
 7. Apply material at not less than manufacturer's instructed spreading rate.
 8. Do not exceed maximum single coat thickness instructed by coating manufacturer.
 9. Ensure that edges, corners, crevices, welds, and exposed fasteners, receive dry film thickness equivalent of flat surfaces.
 10. Finish edges of coatings adjoining other materials and colors sharp and clean manner, without overlapping.
- B. Apply initial coat to surfaces as soon as practical after preparation and before subsequent surface deterioration.
- C. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- D. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.
- E. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils (0.8 mm).

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

- C. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- D. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- E. Allow previously applied coat to dry before next coat is applied.
- F. Sand and dust lightly between coats as recommended by coating manufacturer.
- G. Apply each coat to achieve uniform finish, color, appearance, and coverage free of brush and roller marks, runs, misses, visible laps and shadows, hazing, bubbles, pin holes, and other defects.
- H. Replace trim, fittings, and other items removed for finishing.

3.05 FIELD QUALITY CONTROL

- A. Owner will provide field inspection.
- B. Periodically test film thickness of each coat with wet film gage to ensure coatings are being applied to proper thickness.
- C. Request review of each applied coat by Architect and manufacturer's representative before application of successive coats. Only reviewed coats will be considered in determining number of coats applied.
- D. Immediately prior to Substantial Completion, perform detailed inspection of coated surfaces and repair or refinish abraded, stained, and otherwise disfigured surfaces.
- E. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, and specified thickness, Contractor shall pay for retesting and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations, and specified thickness.

3.06 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.
- D. Refer to Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.07 PROTECTION

- A. Protect finished work from damage.
- B. Correct damage by cleaning, repairing, replacing, and recoating as acceptable to Architect.
- C. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.

3.08 SCHEDULE

- A. Steel Substrates:
 - 1. High-Performance Epoxy System:
 - a. Prime Coat: Polyamidoamine epoxy coating.
 - b. Intermediate Coat: Aliphatic acrylic polyurethane, matching topcoat.
 - c. Topcoat: Aliphatic acrylic polyurethane, sheen as indicated on Finish Schedule.
- B. CMU Substrates:
 - 1. High-Performance Epoxy System:
 - a. Block Filler: Block filler, latex, interior/exterior.
 - b. Intermediate Coat: Polyamidoamine epoxy.
 - c. Topcoat: Aliphatic acrylic polyurethane, sheen as indicated on Finish Schedule.

END OF SECTION

**SECTION 09 9623
GRAFFITI-RESISTANT COATINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Graffiti-resistant coating to exterior cement plaster surfaces and as indicated on Drawings.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.
 - 1. Convene under general provisions of Section 01 7000 - Execution and Closeout Requirements.
 - 2. Required Attendance: Contractor's quality control supervisor or superintendent, Architect, all affected trades, and coating manufacturer.
 - 3. Discuss construction document requirements, required clarifications to construction documents, construction schedule, coordination of affected trades, submittal requirements, approved submittals, and required inspections.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.
 - a. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
 - 2. Sample: 12 by 12 inch (305 by 305 mm) with specific graffiti-resistant coating treatment applied to half of each sample.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
 - 2. Certificate: Certify that products meet or exceed specified requirements.
 - a. Manufacturer's Project Acceptance Document: Certification that manufacturer and installer will warrant the coating for the specific site, design, details, and application indicated for this project.
 - b. Installer Certification: Written document from Manufacturer stating installer is certified, approved, and licensed, or acceptable to install specified products.
 - 3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 4. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.
 - 5. Manufacturer's qualification statement.
 - 6. Installer's qualification statement.
 - 7. Warranties.
- C. Closeout Submittals:
 - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. See Section 01 6000 - Product Requirements, for additional provisions.
 - b. Extra Material: Two gallons (9 liters) of each type installed.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.

- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years experience.
- C. Owner reserves the right to provide continuous independent inspection of surface preparation and application of coatings.

1.06 MOCK-UP

- A. Comply with general mock-up requirements specified in Section 01 4339 - Mockups and Field Samples.
- B. Mock-up: Prepare a representative surface 36 by 36 inch (1 by 1 m) in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
 - 1. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.
 - 2. Locate where directed.
 - 3. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Protect liquid materials from freezing.
- B. Do not apply coating when ambient temperature is lower than 50 degrees F (10 degrees C) or higher than 100 degrees F (38 degrees C).
- C. Do not apply coatings, except with the written recommendation of the manufacturer, when the substrate surfaces have cured for less than a period of 60 days; when rain or temperatures below 50 degrees F (10 degrees C) are predicted for a period of 24 hours; earlier than 3 days after the surfaces became wet from rainfall or other moisture sources; when the substrate is frozen; or on substrate temperature of less than 40 deg F (4 deg C).

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree to repair or replace materials that fail to maintain water repellency within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers - Silane/Siloxane Water Repellents:
 - 1. BASF Construction Chemicals: www.buildingsystems.basf.com.
 - 2. Evonik Industries.
 - 3. PROSOCO, Inc.: www.prosoco.com.

2.02 PERFORMANCE REQUIREMENTS

- A. Performance: Water repellents shall meet the following performance requirements as determined by preconstruction testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
 - 1. Concrete Masonry Units: ASTM C140/C140M.
- C. Water-Vapor Transmission: Comply with one or both of the following:
 - 1. Maximum 10 percent reduction water-vapor transmission of treated compared to untreated specimens, according to ASTM E96/E96M.
 - 2. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, according to ASTM D1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E514/E514M.
- E. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM E514/E514M compared to water-repellent-treated specimens before weathering.
- F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
 - 1. Reduction of Water Absorption: 80 percent.
 - 2. Reduction in Chloride Content: 80 percent.

2.03 MATERIALS

- A. General: Comply with volatile organic compound (VOC) product requirements specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green.
 - 1. Coating Maximum Product Emissions Limits: Coatings must meet current requirements for VOC (Volatile Organic Compounds) limits of SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - a. CAL-Green Requirements for coatings:
 - 1) Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
 - 2) Flats: 50 grams per liter of product minus water.
 - 3) Non-flats: 100 grams per liter of product minus water.
 - 4) Non-flat High Gloss: 150 grams per liter of product minus water.
 - 5) Concrete/masonry sealers: 100 grams per liter of product minus water.
 - 6) Low Solids Coatings: 120 grams per liter of product minus water.
- B. Specific product to be used will be determined by side-by-side mock-up testing of at least three products meeting specified requirements; prepare mock ups as specified above; submit cost breakdown for each product used in mock-up, including both unit and total costs.
- C. Coatings: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
 - 1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
- D. Water Repellent: Clear, solvent-based silicone elastomer waterproofer.
 - 1. Basis of Design Manufacturer:
 - a. PROSOCO, Inc.; Sure Klean Weather Seal Blok-Guard & Graffiti Control: www.prosoco.com.
- E. Exterior Graffiti Coating: Two-component, solvent-based aliphatic urethane coating system; non-glossy, colorless, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
 - 1. Basis of Design Manufacturer:

- a. Euclid Chemical Company; TAMMS AG 400 Permanent Anti-Graffiti Coating: www.euclidchemical.com.
 - b. PROSOCO, Inc.; Weather Seal Blok-Guard & Graffiti Control: www.prosoco.com.
- F. Exterior Graffiti Coating: Clear, water-based sacrificial coating; non-glossy, colorless, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
- 1. Basis of Design Manufacturer:
 - a. PROSOCO, Inc.; Defacer Eraser Sacrificial Coating SC-1: www.prosoco.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 - 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protection of Adjacent Work:
 - 1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
 - 2. Protect adjacent surfaces not intended to receive coatings.
- B. Prepare surfaces to be coated as recommended by coating manufacturer for best results.
- C. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of graffiti-resistant coating, according to graffiti-resistant coating manufacturer's written instructions.
- D. Cleaning: Before application of graffiti-resistant coating, clean substrate of substances that could impair penetration or performance of product according to graffiti-resistant coating manufacturer's written instructions
- E. Remove loose particles and foreign matter.
- F. Remove oil and foreign substances with a chemical solvent that will not affect coatings.
- G. Scrub and rinse surfaces with water and let dry.
- H. Coordination with Sealant Joints: Do not apply water-repellent until sealants for joints adjacent to surfaces receiving graffiti-resistant coating treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water-repellent, and sealant materials identical to those required.

3.03 APPLICATION

- A. Apply in accordance with coating manufacturer's instructions, using procedures and application methods recommended as producing the best results.

- B. Location: Cement plaster, ground to 7'-6" above finish floor, or as indicated on Drawings.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of graffiti-resistant coating and to instruct applicator on the product and application method to be used.
- D. Apply coating of water-repellent on surfaces to be treated using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
- E. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.
- F. Remove coating from unintended surfaces immediately by a method instructed by coating manufacturer.
- G. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's "best practices" for preparation and application are being followed.

3.04 FIELD QUALITY CONTROL

- A. Testing of Graffiti-Resistant Coating Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when graffiti-resistant coating is being applied:
 1. Owner will engage the services of a qualified testing agency to sample graffiti-resistant coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of graffiti-resistant coating material with product requirements.
 3. Owner may direct Contractor to stop applying graffiti-resistant coating if test results show material being used does not comply with product requirements. Remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

3.05 CLEANING

- A. Immediately clean water-repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

**SECTION 10 1100
VISUAL DISPLAY UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Porcelain enamel steel markerboards.
- B. Tackboards.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
 - 2. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
 - 3. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.
- B. Informational Submittals:
 - 1. Manufacturer's printed installation instructions.
 - 2. Maintenance Data: Include data on regular cleaning, stain removal, and other pertinent data.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

1.04 WARRANTY

- A. Provide 15 year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturers - Visual Display Boards:
 - 1. Claridge Products and Equipment, Inc.: www.claridgeproducts.com.
 - 2. Other Acceptable Manufacturers - Visual Display Boards:
 - a. ACCO Brands: www.acco.com.
 - b. ADP Lemco, Inc.: www.adplemco.com.
 - c. Ghent Manufacturing, Inc.: www.ghent.com.
 - d. MooreCo, Inc.: www.moorecoinc.com.
 - e. Polyvision Corporation (Nelson Adams): www.polyvision.com.
 - f. Visual Specialties, Inc.: www.academicsspecialties.com.
 - g. Approved equal.

2.02 VISUAL DISPLAY UNITS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch (0.61 mm).
 - 3. Core: Honeycomb, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on Drawings.
 - 6. Height: 48 inches (1220 mm).
 - 7. Length: 6 feet (1830 mm), in one piece.

8. Frame: Extruded aluminum, with concealed fasteners.
 9. Accessories: Provide marker tray.
 - a. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches (25 to 50 mm) wide.
 - b. Chalk Tray: No. 263.
 - c. Provide 2 map hooks for each 4 feet of map rail.
 - d. End Stops: Located at each end of map rail.
 - e. Flag Holder: One for each room.
 10. Basis of Design Product:
 - a. Claridge Products and Equipment, Inc.; Series 4.
- B. Tackboards: Fine-grained, homogeneous natural cork.
1. Cork Thickness: 1/4 inch (6 mm).
 2. Fabric: Vinyl coated fabric.
 3. Color: As selected by Architect from manufacturer's full range.
 4. Backing: Fiberboard, 3/4 inch (19.05 mm) thick, laminated to tack surface.
 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 6. Height: 48 inches (1220 mm).
 7. Length: 6 feet (1830 mm), in one piece.
 8. Frame: Same type and finish as for chalkboard.
 9. Frame Profile: Manufacturer's standard.
 10. Frame Finish: Anodized, natural.

2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

2.04 ACCESSORIES

- A. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches (760 mm) above finished floor.
- C. Secure units level and plumb.
- D. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
 1. Fabricate re-wrapped edges where partial panels abut each other, or adjacent surfaces or trim.
 2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
 - a. Wrap minimum 2 inches (51 mm) around back of panel.

- b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION

SECTION 10 1414

SIGNAGE

PART 1- GENERAL

1.01 SUMMARY

- A. Section Includes:
 1. Regulatory signage posted at the following permanent locations.
 - a. Restroom doors.
 - b. Egress Stairway Doors.
 - c. Exit doors.
 2. Supplementary components and accessories necessary for a complete installation.
 3. Plaques
 4. Graphic film.

1.02 ADMINISTRATIVE REQUIREMENTS:

- A. Sequencing: Complete all finishing operations, including painting, before beginning installation of signage systems.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data.
 2. Shop Drawings: For panel signs.
 - a. Include fabrication and installation details and attachments to other work.
 - b. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - c. Show message list, type styles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
 - d. Show locations of electrical service connections.
 - e. Include diagrams for power, signal, and control wiring.
 3. Samples for Verification: For each type of sign assembly showing all components and with the required finishes, in manufacturer's standard size unless otherwise indicated and as follows:
 - a. Room-Identification Signs: Full-size Sample.
 - b. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
 - c. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - d. Exposed Accessories: Full-size Sample of each accessory type.
 4. Template: Submit full-size template drawing for approval of letter size, stock, spacing, setting screws.
 5. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- B. Informational Submittals:
 1. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
 - a. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Sample Warranty: For special warranty.
 3. Maintenance Data: For signs to include in maintenance manuals.

1.04 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years of documented experience.
- B. Quality Standard Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines, CBC Chapter IIB, Section 216.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.
- B. California Regulatory Requirements:
- C. Sign Schedule: Provide signage as required by codes and accessibility regulations and requirements. These include, but are not limited to:
 - 1. Illuminated Exit Signs: Refer to Division 26.
 - 2. Fire Doors (CBC Section 1008)
 - 3. Room Capacity (CBC Section 1004.3)
 - 4. Elevator Signs (CBC Section 3002.3)
 - 5. Stairway Identification (CBC 1009 and 11B-703)
 - 6. Accessibility signs (ADA Accessibility 28 CFR 35 Requirements including Braille) including toilet facilities, doors to exitways. (CBC Sections 11B-703).
- D. Raised characters shall comply with CBC Section 11B-703.2:
 - 1. Depth: It shall be 1/32 inch (0.8 mm) minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
 - 2. Height: It shall be 5/8 inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter "I". CBC Section 11B-703.2.5
 - 3. Finish and contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1
 - 4. Proportions: It shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character. CBC Sections 11B-703.2.4 and 11B-703.2.6
 - 5. Character Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8
 - 6. Format: Text shall be in a horizontal format. CBC Section 11B-703.2.9
 - 7. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed or rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.

8. Mounting height: Tactile characters on signs shall be located 48" minimum to the baseline of the lowest Braille cells and 60" maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. CBC Section and Figure 11B-703.4.1
9. Mounting location: A tactile sign shall be located per CBC Section and Figure 11B -703.4.2 as follows:
 - a. Alongside a single door at the latch side.
 - b. On the inactive leaf at double doors with one active leaf.
 - c. To the right of the right hand door at double doors with two active leaves.
 - d. On the nearest adjacent wall where there is no wall space at the latch side of a single door or at the right side of double doors with two active leaves.
 - e. So that a clear floor space of 18" x18" minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
- E. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40 inches minimum above finish floor or ground.
- F. Pictograms shall comply with CBC Section 11B-703.6.
- G. Symbol of accessibility shall comply with CBC Section 11B-703.7.
- H. Variable message signs shall comply with CBC Section 11B-703.8.

2.02 SIGN MATERIALS

- A. Acrylic Plastic: "Plexiglas" by Rohm & Haas, or equal.
 1. Provide non-glare with fine sanded edges.
 2. Exterior grade acrylics and finishes must be used for all exterior room sign conditions.
- B. Specialty Acrylic: Blue tinted acrylic - Finish and thickness as indicated on the Drawings. Manufacturer: Cyro - Acrylite, GP-FL #6157-0 Blue, or equal.
- C. Vinyl: Computer cut with a minimum 5 year exterior and seven 7 year interior guarantee. Sizes, spacing and fonts as indicated on the drawings. Vinyl shall be premium grade unless otherwise specified as manufactured by 3M, Gerber or equal.

2.03 DOOR SIGNS

- A. Toilet Room Doors:
 1. Conform to Title 24 with sign at center of toilet room door at 60 inches (1524 mm) above the finished floor. Do not use raised pictograms and text on door signs.
 - a. Sign Panels: Sign panel material shall be solid acrylic at interior and 1/4 inch (6.35 mm) aluminum or zine at exterior with eased square edges of 1/4 inch (6.35 mm) thickness.
 - b. Graphics: Graphics shall be first surface screen printed, utilizing screens that have been photographically reproduced from Owner-approved electronic files and shall follow dimensions and spacing qualities verba- tim.
 - c. Edge finish: All visible edges shall be painted with polyurethane paint. Saw marks, kerfs, rough or uneven edges shall be unacceptable. Edges shall be precision machined and visually smooth.
 - d. Mounting: 3M #4432 black foam tape, 1/2 inch (12.70 mm) wide, at all perimeter sign edges.
 - e. Color:
 - 1) Paint color to match Campus Standard Colors
 - 2) Screen print color to match Campus Standard Colors..
 - 3) Sign color shall contrast with door color.
 2. Women: 12 inch (305 mm) diameter circle by 1/4 inch (6.35 mm) thick.
 3. Men: 12 inch (305 mm) by 12 inch (305 mm) by 1/4 inch (6.35 mm) thick.
 4. Single Accommodation: Overlay 12 inch (305 mm) by 1/4 inch (6.35 mm) triangle to contrasting 12 inch (305 mm) diameter circle 1/4 inch (6.35 mm) thick.

- a. Unisex toilet rooms shall be identified with required geometric symbols per 11B-703.7.2.6. When tactile identification is provided it shall not include pictograms.

2.04 ROOM IDENTIFICATION SIGNS, TOILET ROOM IDENTIFICATION SIGNS (WALL), AND INTERIOR DIRECTIONAL SIGNS

- A. Painted acrylic sign backer with eased edges and multipolymer acrylic sign face with eased edges, photopolymer process to produce raised letter and Braille at interior. Painted Aluminum or zinc plaque with eased edges, surface etched to produce raised numbers and Braille at exterior.
 - 1. Mounting: 3M #4432 black foam tape (1/2 inch (12.70 mm) wide) at all perimeter edges, or appropriate silicone adhesive as needed.
 - 2. Colors: Match Campus Standard Colors.
 - 3. Size and Design: Match Campus Standard Colors.
 - 4. Interior Directional Signs: Provide a base bid allowance of five interior directional signs.
 - a. Two layers of 1/8 inch (3.17 mm) acrylic, exposed edges eased, painted.
 - b. Changeable message strips with screen-printed messages secured with roll adhesive, removable.
 - c. Mounting: 3M #4432 black foam tape (1/2 inch (12.70 mm) wide) at all perimeter edges, or appropriate silicone adhesive as needed.
 - d. Colors: to match Campus Standard Colors.
 - e. Size and Design to match Campus Signage Standard.

2.05 EXIT

- A. Exits, which are required to be identified as such by the Fire Marshal shall also be identified by sign with raised characters and Braille which conforms to ANSI 117.1 (703.2 or 703.3). The following designations shall be provided:
 - 1. EXIT (For an unlocked exit door without an alarm, leading to the exterior of the building.)
 - 2. TO EXIT (for an unlocked exit door without an alarm leading to a corridor, hallway, exit enclosure, or exit passageway).
 - 3. Painted acrylic sign backer with eased edges and multipolymer acrylic sign face with eased edges, photopolymer process to produce raised letters and Braille at interior.
 - 4. Painted aluminum or zinc plaque with eased edges, surface etched to produce raised numbers and Braille at exterior.
 - 5. Mounting: 3M #4432 black foam tape (1/2 inch (12.70 mm) wide) at all perimeter edges, or appropriate silicone adhesive as needed.
 - 6. Colors: to match Campus Standard Colors

2.06 ENTRY SIGNS

- A. ISA (International Symbol of Accessibility) sign:
 - 1. Screen printed or cut vinyl graphics reverse-reading on inside face of glass doors and front reading on exterior face of door.
 - 2. Mounting: Self-adhesive.
 - 3. Colors: Design to match Campus Standards.
 - 4. Signs shall be installed or mounted with bottom edge of sign 18 inches from finish floor or ground surface. Sign may be mounted on window or on door itself.

2.07 WALL-MOUNTED PHOTOPOLYMER (ONE-PIECE) PANEL SIGNS

- A. Description: Single-piece construction, permanent identification signs consisting of moisture resistant, non-glare photopolymer bonded to sign base material.
- B. Products: Design is based on interior grade photopolymer panels by Jet USA.
- C. Comply with the Following:
 - 1. Sizes:
 - a. Restroom Signs:
 - 1) Women's Room: 12 inch (305 mm) diameter circle.

- 2) Men's Room: Equilateral triangle with 12 inch (305 mm) long edges and vertex pointing upward.
- b. Egress Stairway Doors: 12 inches (305 mm) square.
- c. Exit Passageway Doors: 12 inches (305 mm) square.
- d. Exit Discharge Doors: 12 inches (305 mm) square.
- 2. Thickness: Between 1/8 inch (3.17 mm) minimum and 1/4 inch (6.35 mm) maximum.
- 3. Edge Condition: Square cut.
- 4. Corner Condition: Square.
- 5. Mounting: Wall mounted with mechanical fasteners or adhesive.
- 6. Materials:
 - a. Photopolymer Layer: 0.040-inch acrylic photopolymer.
 - b. Base Material:
 - 1) Interior Locations: "Jet 388" 0.120-inch phenolic base.
 - 2) Interior Locations: "Jet 388 EX" exterior grade photopolymer applied to a 0.120-inch phenolic base.
 - c. Colors: As selected by Architect from Manufacturer's full range.
- 7. Sign Text:
 - a. Copy: Copy must follow the dimensions and spacing indicated on the Design Drawings and/or approved copy patterns.
 - 1) Letter spacing must conform to standards shown and kerned optically to the acceptance of the Owner.
 - 2) Lines of copy must be straight and parallel to the sign format, unless otherwise specified.
 - 3) Edges of letters, numbers, and symbols must be smooth and continuous, with straight and curved portions reproducing the original forms exactly, with corners sharp and true.
 - 4) All form shall be free of ticks, line waiver, discontinuous curves and other imperfections.
 - b. Font: As selected by Architect.

2.08 GRAPHIC FILM

- A. Graphic Film:
 - 1. Adhesive Color: Gray.
 - 2. Adhesive: Manufacturer's standard.
 - 3. Adhesive Features: Air-release, slideability.
 - 4. Color Effect: Metallic.
 - 5. Color: White.
 - 6. Film Type: Cast.
 - 7. Imaging Method: Digital print.
 - 8. Liner: PE coated kraft paper.
 - 9. Opacity: Transparent.
 - 10. Surface Finish: Luster.
 - 11. Product:
 - a. 3m: Controltac IJ180Cv3
- B. Primer/Sealer: Zinsser; All-Prime Clear.
- C. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
 - 1. Free of volatile organic compounds (VOC); wall covering manufacturer's recommended

2.09 ACCESSIBLE PARKING SIGNS

- A. Screen printed, 12 gage, 0.105 inch (2.66 mm) bonderized steel with blue baked enamel finish and white e screen printed copy.
- B. Size: 12 by 18 inches (305 by 457 mm) and 12 by 18 inches (305 by 457 mm) .

- C. Copy:
 - 1. "Accessible Parking Only".
 - 2. "Van Accessible".
 - 3. "Maximum Fine \$250"
 - 4. " Unauthorized vehicles parked in designated accessible spaces not displaying distinguishing placards or special license plates issued for persons with disabilities will be towed away at the owner's expense.
 - a. Towed vehicles may be reclaimed at...
 - b. Or by telephoning..."
 - 5. See drawings for additional copy
- D. Acceptable Products:
 - 1. Accessible Parking: Best Traffic Signs No. SS04 with SS52 as required.
- E. Post: Galvanized pipe column minimum 9 feet long.

2.10 ACCESSORIES

- A. Fasteners: Non-removable mechanical fasteners and anchors suitable for secure attachment to substrate and placed through predrilled holes as recommended in writing by the sign manufacturer.
- B. Signs Mounted on Glass: Provide blanks on opposite side of glass, match sign.
- C. Adhesives: As furnished, required, recommended, approved or accepted by the sign manufacturer for a secure and permanent installation.
 - 1. LEED Requirements - LEED Credit EQc4.1 - Adhesives shall meet low VOC content as determined by LEED requirements.
 - a. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
 - b. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
 - c. Do not use adhesives that contain urea formaldehyde.
 - 2. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of SCAQMD 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit, and Cal GREEN Table 5.504.4.2 Sealant VOC Limit requirements.
 - a. Current requirement refers to the date on which the materials are installed in the building.
 - b. A copy of SCAQMD 1168 is referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
- D. VOC Limits: Provide paints and coatings with VOC content not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
 - 1. Methylene chloride and perchloroethylene may not be intentionally added to paints and coatings.
- E. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of SCAQMD 1113 and CAL-Green Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. CAL-Green Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
 - b. Flats: 50 grams per liter of product minus water.
 - c. Non-flats: 100 grams per liter of product minus water.
 - d. Non-flat High Gloss: 150 grams per liter of product minus water.

- F. Other Accessories: Provide other accessories and similar secondary items, including and cleaning agents selected by the Contractor, as furnished, required, recommended, approved or accepted by the sign manufacturer.

2.11 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.
 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Shop-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that surfaces to receive signs are clean and free of materials or debris that would impair installation.
- C. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate prior to the start of installation in order to remove dust, debris and loose particles

3.03 INSTALLATION

- A. General:
 1. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer-prepared instructions.
 2. Install signage systems level and plumb at the height indicated on the drawings.
 3. Install signs on walls adjacent to latch side of door where applicable.
 - a. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls.
 - b. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

3.04 INTERIOR INSTALLATION - ROOM SIGNS

- A. Install signs plumb, level and square and in proper planes with other work, at heights as indicated by Architect.
- B. Mount on wall surface, 60 inches maximum above finish floor surface to the base line of the highest line of raised characters, 4 inches from door frame to meet ADA and CBC Accessibility Requirements.
- C. Anchor each plastic sign with sufficient amount adhesive for proper installation as recommended by manufacturer for substrate.
- D. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.
- E. Mounting Methods:
 - 1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- F. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

3.05 EXTERIOR INSTALLATION - PARKING SIGNS

- A. Mount posts in 12 inch (305 mm) round by 30 inches (762 mm) deep concrete footing.

3.06 CLEANING

- A. Cleaning Installed Work:
 - 1. Clean exposed metal surfaces of substances that might interfere with uniform oxidation and weathering.
 - 2. Leave work areas around Project site free of debris and related items after completion of the Work of this Section.

3.07 PROTECTION

- A. Protect installed signs in place against damage until Substantial Completion.
- B. Remove protection when no longer needed and prior to Substantial Completion.

END OF SECTION

**SECTION 10 1435
DIMENSIONAL SIGN CHARACTERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flat cut-out aluminum sign characters and symbols.
- B. Mounting hardware and attachment accessories.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product data for each product type.
 - 2. Shop Drawings: Indicate sign styles, lettering font, locations, overall dimensions of each sign.
 - a. Include fabrication and installation details and attachments to other work.
 - b. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - c. Show message list, type styles, graphic elements, and layout for each sign.
 - d. Show locations of electrical service connections.
 - e. Include diagrams for power, signal, and control wiring.
 - 3. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - a. Include representative Samples of available typestyles and graphic symbols.
 - 4. Samples: Submit three samples illustrating type, style, letter font, and colors specified, and method of attachment.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 4. A5.405.1 Regional materials. Select building materials or products for permanent installation on the project that have been harvested or manufactured in California or within 500 miles of the project site, meeting the criteria listed in Section A5.405.1.
 - 5. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.
 - 6. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Package signs, labeled in character groups.

1.06 WARRANTY

- A. When warranties are required, verify with Owner's counsel that warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

- B. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Verify available warranties and warranty periods for units and components.
 - 3. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. A. R. K. Ramos.
 - 2. ASI-Modulex, Inc.
 - 3. Gemini Incorporated.
 - 4. Matthews International Corp..
 - 5. Metal Arts; Div. of L&H Mfg. Co.
 - 6. Southwell Company (The).
 - 7. Approved equal.

2.02 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
 - 1. Character Material: clear anodized aluminum, smooth finish on face and all sides
 - 2. Character Thickness: As indicated on Drawings..
 - 3. Character Height: As indicated on Drawings
 - 4. Finishes:
 - a. Clear Anodized
 - 5. Mounting: Concealed studs.
 - 6. Typeface and Message: As indicated on Drawings.

2.03 MATERIALS

- A. Aluminum: Clear Anodized

2.04 ACCESSORIES

- A. Pins and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
- B. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - 1. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
- C. Mounting Hardware: Non-corrosive, concealed fasteners and mounting brackets as designed by manufacturer to suit mounting conditions.

2.05 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Fabricated Characters and Symbols: Cut components from solid sheet and plate material. Produce smooth, even, flat surfaces, and precisely cut lines and edges.

2.06 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 FINISH

- A. Aluminum: Clear anodized smooth finish with Clear Anti-Graffiti Coating

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. **Concealed Studs:** Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. **Masonry Substrates:** Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. **Thin or Hollow Surfaces:** Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

C. Install in accordance with manufacturer's instructions.

D. Provide heavy-weight paper template to establish character spacing and to locate holes for fasteners.

E. Mounting: Mount characters and symbols at projection distance of 1/4 inch from wall surface.

F. Locate character composition on wall surface, level.

3.03 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

**SECTION 10 2113.17
PHENOLIC TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal and vestibule screens.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.03 SUBMITTALS

- A. Product Data: Provide data on panel construction, hardware, and accessories.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Manufacturer's Installation Instructions: Indicate special procedures.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.06 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Products:
 - 1. Bradley Corp.; Sentinel, Series 400: www.bradleycorp.com.
 - 2. Bobrick Washroom Equipment, Inc.; DuraLineSeries 1080: www.bobrick.com.
 - 3. Prior approved equal.
 - 4. Other Acceptable Manufacturers:
 - a. General Partitions Mfg. Corp.: www.generalpartitions.com.
 - b. Global Steel Products Corp.: www.globalpartitions.com.
 - c. Accurate Partitions Corp.: www.accuratepartitions.com.
 - d. Ampco Products, Inc.: www.ampco.com.
 - e. Approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.

- B. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9 inches high minimum above the finish floor and 6 inches deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12 inches high minimum above the finish floor for children's use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66 inches wide.
- C. An ambulatory accessible compartment shall be provided where there are six or more toilet compartments , or where the combination of urinals and water closets totals six or more per CBC Section 11B-213.3.1. Such compartment shall comply with CBC Section 11B-604.8.2.
- D. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that pull-side clearance for ambulatory accessible compartments shall be minimum 44" clear, rather than 60". CBC Figure 11B-604.8.2.
- E. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.
- F. Doors shall not swing into clear floor space or clearance required for any fixtures .

2.03 PHENOLIC TOILET COMPARTMENTS

- A. General: Provide no-sightline system into toilet compartments.
- B. Toilet Compartments: Factory fabricated Doors, divider panels, and pilasters made of solid phenolic core panels with integral melamine finish, floor-mounted unbraced.
- C. Doors:
 - 1. Thickness: 3/4 inch (19 mm).
 - 2. Width: 24 inch (610 mm).
 - 3. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
 - 4. Height: As indicated on Drawings..
- D. Panels: Mount to wall with continuous panel brackets.
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Height: 58 inch (1473 mm).
 - 3. Depth: As indicated on drawings.
- E. Pilasters:
 - 1. Thickness: 3/4 inch (19 mm).
 - 2. Width: As required to fit space; minimum 3 inch (76 mm).
- F. Urinal Screens: Wall mounted with continuous panel brackets.
 - 1. Minimum Size: 24 inches (610 mm) wide by 48 inches (1219.20 mm) high, bottom edge positioned 12 inches (305 mm) above floor surface.
 - 2. Thickness: 1/2 inch (13 mm).

2.04 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch (76 mm) high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch (25 mm by 38 mm) size, with anti-grip profile and cast socket wall brackets.
- C. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.

- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- E. Hardware: Polished stainless steel:
 - 1. Full Height Hinges: Heavy-gauge type 304 stainless steel
 - 2. Nylon bearings.
 - 3. Thumb turn door latch with exterior emergency access feature.
 - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 5. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 6. Door Pull: Manufacturer's standard unit at all out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicap accessible, and to comply with accessibility requirements of authorities having jurisdiction. Mount between 34 inches and 44 inches above finish floor.
 - 7. Fasteners: Pin-in- head Torx internally-threaded through-bolt fasteners.

2.05 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Floor-Anchored Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
 - 1. Floor-Anchored Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- D. Attach panel brackets securely to walls using anchor devices.
- E. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- F. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2239
FOLDING PANEL PARTITIONS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Horizontal folding panel partitions.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.
 2. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, stacking depth, and diagrams for power, signal, and control wiring.
 3. Samples for Selection: Submit three samples of full manufacturer's color range for selection of colors.
 4. Samples for Review: Submit six samples of surface finish, 12 by 12 inches (300 by 300 mm) size, illustrating quality, colors selected, texture, and weight.
- B. Informational Submittals:
 1. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
 2. Manufacturer's Instructions: Indicate special procedures.
 3. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide special submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 2. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 3. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this Section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this Section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used in shop drawings. Do not use permanent markings on panels.

1.08 FIELD MEASUREMENTS

- A. Verify partition openings and storage arrangements by field measurements before fabrication, and indicate measurements on shop drawings.

1.09 MAINTENANCE MATERIALS

- A. Furnish extra panel finish materials, matching installed materials, in quantity to cover both sides of two typical panels when installed.
- B. Package maintenance materials with protective covering for storage, identified with descriptive labels.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of operable panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer Folding Panel Partitions - Horizontal Opening:
 - 1. Advanced Equipment Corporation: www.advancedequipment.com.
 - 2. Other Acceptable Manufacturers:
 - a. Hufcor, Inc: www.hufcor.com.
 - b. Modernfold, a DORMA Group Company: www.modernfold.com.
 - c. Panelfold, Inc: www.panelfold.com.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

- A. Folding Panel Partitions: Side opening; paired panels; side stacking; manually operated.
- B. Panel Construction:
 - 1. Frame: 16 gauge, 0.0598 inch (1.52 mm) thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
 - 2. Substrate: Gypsum board.
 - 3. Panel Substrate Facing: Steel sheet, manufacturer's standard thickness laminated to gypsum board panel.
 - 4. Aluminum, clear anodized vertical edge trim that overlaps the panel face and secures finish at vertical edge.
 - 5. Hinges: SOSS Invisible laminated hinge with antifriction segments mounted between each heat-treated link, attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates.
 - 6. Panel Properties:
 - a. Thickness With Finish: 3-1/2 inches (88.90 mm).
 - b. Width: Standard width.
 - c. Acoustical Ratings: 54 STC.
- C. Panel Finishes:

1. Facing: Vinyl coated fabric.

D. Panel Seals:

1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor and ceiling seals, and above track to structure acoustic seal.
3. Vertical Interlocking Sound Seals between Panels: Roll-formed steel astragals, with tongue and groove configuration in each panel edge.
4. Horizontal Top Seals: Fixed, flexible multi-fin.
5. Manual Bottom Seals: 2 inch (50.8 mm) nominal operating clearance with an operating range of plus 1/2 inch (12.70 mm) to minus 1-1/2 inch (38 mm) which drop as panels are positioned. Extended seal shall exert nominal 120 pounds (265 kg) downward force to the floor throughout operating range.

E. Suspension System:

1. Track: Composite track, aluminum case with steel running surface.
 - a. Track soffit trim shall be integral to track.
 - b. Track brackets interlock with top flange of track and attach to structure with pairs of 1/2-inch diameter steel threaded rod. Track joints aligned by concealed, steel dowels.
 - c. Pendant Bolt: 5/8-inch diameter and attach to panel through a steel plate mounted internally with panel frame.
 - d. Carriers: Four, ball-bearing, steel wheels.
2. Product:
 - a. Advanced Equipment Corporation; No. 2.

2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Vinyl Coated Fabric: ASTM F793/F793M, Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.

2.04 PARTITION FABRICATION

- A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so that finished in-place partition is rigid, level, plumb, aligned, with uniform appearance, free of warp, bow, twist, deformation, and surface irregularities.
- B. Dimensions: Fabricate operable panel partitions to form an assembled system of dimensions indicated on Drawings, and verified by field dimensions.
- C. Trim Finish: Manufacturer's standard aluminum trim; clear anodized.
- D. Hardware: Manufacturer's standard as required to operate panel partitions and accessories, with protective finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Verify that field measurements are as indicated.

- C. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.
- D. Verify track supports are laterally braced and will permit track to be level within 1/4 inch (6.4 mm) of required position and parallel to the floor surface.
- E. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.
- F. Verify wall plumbness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Install electric operator, wiring, and controls. Locate control station(s) as indicated.
- C. Fit and align partition assembly and pocket doors level and plumb.
- D. Lubricate moving components.
- E. Install acoustic sealant to achieve required acoustic performance.
- F. Coordinate electrical connections.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
- C. Verify that safety devices are properly functioning.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

3.04 FIELD QUALITY CONTROL

- A. NIC Testing: Engage a qualified testing agency to perform tests and inspections.
 1. Testing Methodology: Perform testing of installed operable panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
 2. An operable panel partition installation will be considered defective if it does not pass tests and inspections.
 3. Prepare test and inspection reports.

3.05 CLEANING

- A. Clean finish surfaces and partition accessories.

3.06 CLOSEOUT ACTIVITIES

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

B. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION

SECTION 10 2600
WALL AND DOOR PROTECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Crash rails.
- B. Corner guards.
- C. Protective wall covering.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
 - 2. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - a. Submit two sections of corner guards, 24 inches (610 mm) long.
- B. Informational Submittals:
 - 1. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
 - 2. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- D. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

PART 2 PRODUCTS**2.01 PRODUCT TYPES**

- A. Refer to Finish Schedule for selected products and finishes.
- B. Bumper Rails - Option A: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
 - 1. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/lineal ft (1,400 N/m) with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs (1112 N) at any point without damage or permanent set.
 - 2. Material: Rubber; UV-resistant, black, uniform in color, smooth surface, with extruded aluminum retainer.

3. Mounting: Surface.
 4. Basis of Design Product:
 - a. Pawling Corporation; EB-15 Industrial Wall Guard.
 - b. Approved equal.
- C. Bumper Rails - Option B: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
1. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/lineal ft (1,400 N/m) with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs (1112 N) at any point without damage or permanent set.
 2. Material: Rubber; UV-resistant, black, uniform in color, smooth surface.
 3. Mounting: Surface.
 4. Basis of Design Product:
 - a. Pawling Corporation; E-1 Extruded Bumber.
 - b. Approved equal.
 - 5.
- D. Corner Guards - Surface Mounted:
1. Material: High impact vinyl with full height extruded aluminum retainer.
 2. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 3. Width of Wings: 3 inches (76 mm).
 4. Height: 48 inches (1220 mm).
 5. Corner: Square.
 6. Color: As selected from manufacturer's standard colors.
 7. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 8. Length: One piece.
 9. Mounting: Adhesive.
 10. Basis of Design Product:
 - a. Pawling Corporation; CG-10 Corner Guard.
 - b. Approved equal.
- E. Corner Guards - Flush Mounted:
1. Rigid vinyl corner guard.
 2. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 3. Width of Wings: 2-1/2 inches (64 mm).
 4. Height: 48 inches (1220 mm).
 5. Corner: 90 degrees.
 6. Color: As selected from manufacturer's standard colors.
 7. Basis of Design Manufacturer:
 - a. Pawling Corporation; CG-3 Heavy Duty Corner Guard.
 - b. Approved equal.
- F. Adhesives and Primers: As recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.

1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position top of bumper rail 36 inches (914 mm) from finished floor.
- C. Position corner guard 4 inches (102 mm) above finished floor to height indicated on Drawings.
- D. Terminate rails 1 inch (25.4 mm) short of door openings and intersecting walls.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

**SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Under-lavatory pipe supply covers.
- C. Diaper changing stations.
- D. Utility room accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate locations of accessories with other work to avoid interference, and to assure proper operation and servicing of accessory units.
 - 2. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.04 QUALITY ASSURANCE

- A. Provide accessories by the same manufacturer for each type of accessory unit, and for units exposed in the same areas, to ensure matching of finishes.
- B. Comply with ASTM F446 for grab bars and accessories, anchorage, test methods, and performance.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.
- B. Pack accessories individually in a manner to protect accessory and its finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer Commercial Toilet, Shower, and Bath Accessories:
 - 1. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - 2. Other Acceptable Manufacturers Commercial Toilet, Shower, and Bath Accessories:
 - a. A & J Washroom Accessories Inc.: www.ajwashroom.com.
 - b. American Specialties, Inc.: www.americanspecialties.com.
 - c. Bradley Corporation: www.bradleycorp.com.
 - d. GAMCO Commercial Restroom Accessories (Div. of Bobrick): www.gamcousa.com.
 - e. Prior approved equal.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Keys: Provide two keys for each accessory to Owner.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.
- G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 TOILET ROOM ACCESSORIES

- A. Refer to Drawings for selected products and finishes.
- B. Combination Toilet Seat-Cover Dispenser, Toilet Tissue Dispenser, and Waste Disposal: Double roll, recessed, stainless steel unit, tumbler lock, theft resistant spindle, sanitary napkin disposal.
 - 1. Minimum Capacity: 500 seat covers.
 - 2. Waste Receptacle Minimum Capacity: 0.4 gallons (1.5 liters).
 - 3. Products:
 - a. Bobrick; B-3091.
- C. Combination Toilet Seat Cover Dispenser, Toilet Tissue Dispenser, and Waste Disposal: Double roll, surface-mounted, stainless steel unit, tumbler lock, theft resistant spindle, sanitary napkin disposal.
 - 1. Minimum Capacity: 500 seat covers.
 - 2. Waste Receptacle Minimum Capacity: 0.4 gallons (1.5 liters).
 - 3. Products:
 - a. Bobrick; B-30919.
- D. Paper Towel Dispenser:
 - 1. Product:
 - a. Kimberly Clark Professional, Hard Roll Towel Dispenser #34364 Black
- E. Waste Receptacle: Surface mounted, stainless steel, seamless lower door for access to container, with tumbler lock, reinforced panel full height of door, push-in self-closing top door, continuously welded bottom pan and seamless exposed flanges.
 - 1. Liner: Removable seamless stainless steel receptacle.
 - 2. Minimum Capacity: 6.4 gallons (24.2 liters).
 - 3. Products:
 - a. Bobrick; B-279.
- F. Soap Dispenser: Liquid soap dispenser, wall-mounted, with plastic cover.
 - 1. Products:

- a. GOJO/FMX Soap Dispenser #5277-06.
- G. Mirror: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
 - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - 2. Size: As indicated on drawings.
 - 3. Frame: 3/4 inch (19 mm) angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 - 4. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.
 - 5. Product:
 - a. Bobrick; B-290 1830.
 - b. Prior approved equal.
- H. Grab Bars : Stainless steel, textured surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 - b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, with snap-flange cover, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Length and Configuration:
 - 1) 36 inches long
 - 2) 42 inches long
 - d. Finish: Polished stainless steel.
 - e. Products:
 - 1) Bobrick; B-6806.
- I. Combination Sanitary Napkin/Tampon Dispenser: Stainless steel, surface-mounted.
 - 1. Door: Seamless 0.05 inch (1.3 mm) door with returned edges and tumbler lock.
 - 2. Cabinet: Fully welded, 0.03 inch (0.8 mm) thick sheet.
 - 3. Operation: 25 cent coin required to operate dispenser. Provide locked coin box, separately keyed.
 - 4. Identify dispensers slots without using brand names.
 - 5. Minimum Capacity: 20 napkins and 30 tampons.
 - 6. Product:
 - a. Bobrick; B-47069-25.
- J. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F 2285.
 - 1. Style: Horizontal.
 - 2. Material: Stainless steel shell with polyethylene body.
 - 3. Mounting: Recessed.
 - 4. Color: As selected by Architect from manufacturer's full range.
 - 5. Minimum Rated Load: 250 lbs (113.4 kg).
 - 6. Liner Dispenser: Built in.
 - 7. Operation: Pneumatic shock absorbing mechanism.
 - 8. Basis of Design Product:
 - a. Koala Kare Products; KB110-SSRE: www.koalabear.com.
- K. Hat and Coat Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped plate and backplate for exposed attachment, satin finish.
 - 1. Mounting Screws: Pinned Torx-Plus head.
 - 2. Products:
 - a. Bobrick; B-7671.

2.05 SHOWER AND TUB ACCESSORIES

- A. Type SR - Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 1-3/8 inch (35 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for concealed mounting.
 - 1. Products:
 - a. Bobrick; B-207.

- B. Type SCR - Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Material: Vinyl, machine washable, and mildew-resistant.
 - 3. Size: 42 by 72 inches (1065 by 1830 mm), hemmed edges.
 - 4. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
 - 5. Color: Seafoam.
 - 6. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
 - 7. Products:
 - a. Bobrick; B-204-2.

- C. Type SCH - Shower Curtain Hook: 0.09 inch (2mm) diameter, type-304 stainless steel spring loop.
 - 1. Products:
 - a. Bobrick; 204-1.

- D. Type FSS - Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.
 - 3. Product:
 - a. Bobrick; B-5181.

- E. Hat and Coat Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped plate and backplate for exposed attachment, satin finish.
 - 1. Mounting Screws: Pinned Torx-Plus head.
 - 2. Products:
 - a. Bobrick; B-7671.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 - 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 - 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 - 3. Construction: 1/8 inch (3.2 mm) flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Comply with ASTM C1822, type indicated.
 - c. Comply with ASME A112.18.9.
 - d. Comply with ICC A117.1.
 - e. Microbial and Fungal Resistance: Comply with ASTM G21.
 - 4. Color: White.
 - 5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
 - 6. Products:
 - a. Plumberex Specialty Products, Inc; Plumberex Handy-Shield Maxx: www.plumberex.com.

- b. Plumberex Specialty Products, Inc; Plumberex Trap Gear: www.plumberex.com.
- c. Truebro by IPS Corporation; Lav Guard 2 E-Z.
- d. Approved equal.

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
 - 1. Drying Rod: Stainless steel, 1/4 inch (6 mm) diameter.
 - 2. Mop/Broom Holders: 4 spring-loaded rubber cam holders at shelf front.
 - 3. Length: 36 inches (900 mm).
 - 4. Length: Manufacturer's standard length for number of holders/hooks.
 - 5. Products:
 - a. Bobrick; B-224 X 36.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
 - 1. Verify exact location of accessories for installation.
 - 2. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
 - 3. Verify that field measurements are as indicated on Drawings.
- B. See Section 06 1000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.
- C. Before starting work notify Architect in writing of any conflicts detrimental to installation or operation of units.
- D. Verify with Architect exact locations of accessories.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.
- D. Use concealed fasteners wherever possible.
- E. Where exposed mounting devices and fasteners are necessary, provide such devices finished to match accessory; use security type fasteners for all exposed accessory mountings.
- F. Unless otherwise indicated, align accessory units with adjacent fixtures and other elements within the same area. Conform to ANSI/ICC A117.1 for positions and mounting heights.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

- B. Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this Section.
- C. Protect exposed accessory finishes from damage until final acceptance of the Work.

3.05 CLEANING AND ADJUSTMENT

- A. Clean and polish all exposed surfaces after installation, and after removal of labels and protective coatings or coverings.
- B. Test and adjust accessories for proper and smooth operation.

END OF SECTION

**SECTION 10 4116
EMERGENCY ACCESS KEY BOXES**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 1. Fire department emergency access key boxes.

1.02 SYSTEM DESCRIPTION

- A. Emergency Access Key Boxes: High security key-locked vaults approved by Fire Department, sized and configured to house entrance keys to designated spaces and rooms, and accessed by single master key controlled by Fire Department to provide rapid emergency access to those designated spaces and rooms.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Before starting emergency access key box installation, conduct conference at Project site.
 1. Meet with Owner, Architect, and Fire Marshal.
 2. Agenda: Review products, installation procedures and coordination with related work. Coordinate location of emergency access key box with Fire Marshal.

1.04 SUBMITTALS

- A. Action Submittals:
 1. Product Data: For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of postal specialty.
 2. Shop Drawings: For emergency access key box.
 - a. Include plans, elevations, sections, and attachment details.
 - b. Include identification sequence for compartments.
 - c. Include layout of identification text.
 - d. Include setting drawings, templates, and installation instructions for anchor bolts and other anchorages installed as part of the Work of other Sections.
- B. Informational Submittals:
 1. Sample Warranty: For special warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Companies specializing in manufacturing emergency access key boxes with minimum 20 years documented experience.
- B. Installer: Company specializing in installation of emergency access key boxes with minimum 3 documented experience.

PART 2 PRODUCTS

2.01 EMERGENCY ACCESS KEY BOXES

- A. Emergency Access Key Boxes: Heavy duty steel case with hinged door for recessed mounting with UL listed tamper switches.
 1. Basis-of-Design Product:
 - a. Knox Company; KnoxVault 4400: www.knoxbox.com.
 - b. Prior approved equal.
 2. Mounting: Recessed.

3. Case: 1/4 inch (6.35 mm) thick welded steel plate; 30 cubic inch capacity capable of holding up to 50 keys.
4. Size: 9-1/2 inches (241.30 mm) wide by 9-1/2 inches (241.30 mm) high by 4-1/2 inches (114 mm) deep.
5. Recessed Mount Flange: Steel face flange secured to case; 7 inches (177.80 mm) wide by 7 inches (177.80 mm) high.
6. Door: 5/8 inch (15.87 mm) thick solid plate steel with interior gasket seal and stainless steel hinge; 1/8 inch (3.17 mm) thick stainless steel lock cover with hole for tamper proof seal.
7. Lock: Double-action rotating tumblers and hardened steel pins access by biased cut key; keyed to Fire Department master key.
8. Finish: Manufacturer's proprietary finishing process; "aluminum" color.

2.02 ACCESSORIES

- A. Recessed Mounting Kit: Provide manufacturer's standard shell housing and mounting hardware for casting into concrete or setting into masonry construction.
- B. Fasteners: Grade 5 zinc plated steel carriage screws with nuts; fabricated from quenched and tempered steel with minimum 120,000 psi tensile strength; coarse thread; thread length at least 2 times screw diameter plus 1/4 inch (6.35 mm); 3/8 inch (9.53 mm) diameter by lengths sufficient to secure emergency access key box to backing plates at recessed locations and through wall at surface mounted locations.
- C. Sealant: As specified in Section 07 9200 - Joint Sealants.

2.03 FABRICATION

- A. Form emergency access key boxes to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of emergency access key boxes to preclude binding, warping, or misalignment.
- B. Preassemble emergency access key boxes in shop to greatest extent possible to minimize field assembly.
- C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
- D. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.
- E. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.
- F. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

2.04 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer and fire marshal present, for compliance with requirements for roughing-in openings, clearances, and other conditions affecting performance of the Work.
- B. Examine walls and other adjacent construction for suitable conditions before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install emergency access key box in accordance with Fire Department requirements and with manufacturer's instructions and recommendations.
- B. Install emergency access key boxes level and plumb, according to manufacturer's written instructions.
 - 1. Install recess mounted emergency access key boxes flush in non-rated framed construction. Install surface mounted emergency access key boxes in fire-rated framed construction, concrete construction and masonry construction.
 - 2. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer.
 - 3. Where aluminum contacts grout, concrete, masonry, or wood, protect against corrosion by painting contact surfaces with bituminous coating.
- C. Emergency Access Key Boxes: Install emergency access key boxes with centerline not more than 48 inches above finished floor.

3.03 FIELD QUALITY CONTROL

- A. Examine and test emergency access key boxes.

3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as emergency access key boxes are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as recommended by manufacturer. Verify that integral locking devices operate properly.
- C. Touch up marred finishes or replace emergency access key boxes that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by in-wall payment drop box manufacturer.
- D. Replace emergency access key boxes that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- E. On completion of emergency access key boxes installation, clean interior and exterior surfaces as recommended by manufacturer.

END OF SECTION

**SECTION 10 4400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide color and finish, anchorage details, and installation instructions.
 - 2. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
 - 3. Samples: For each type of exposed finish required.
 - 4. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.
 - 5. Product Schedule: For fire-protection cabinets. Indicate whether semirecessed mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
 - 2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 3. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.03 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.
- C. Provide fire extinguisher and cabinet from the same manufacturer.

2.02 FIRE EXTINGUISHER CABINETS

- A. Fire Extinguisher Cabinets FEC-1:
 - 1. Basis of Design Product:

- a. JL Industries, Inc; Cosmopolitan 1035S22: www.jlindustries.com.
- b. Other Acceptable Manufacturers:
 - 1) JL Industries, Inc: www.jlindustries.com.
 - 2) Larsen's Manufacturing Co: www.larsensmfg.com.
 - 3) Prior approved equal.
- 2. Fire Rating: Non-rated.
- 3. Cabinet Type: Recessed.
- 4. Cabinet Material: Steel.
 - a. Color: White.
- 5. Door Material: Stainless steel sheet.
- 6. Door Style: Solid flush panel with frame, square edge.
- 7. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - a. Provide piano hinge permitting door to open 180 degrees.
 - b. Handle: Saffey lock.
- 8. Accessories:
 - a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - b. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - c. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - 1) Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER", on cabinet door, black text, vertical alignment.
 - (a) Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

2.03 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage, with monoammonium phosphate-based dry chemical in enameled-steel container.
 - 1. Stored Pressure Operated: Deep Drawn.
 - 2. Class: 4-A:80-B:C.
 - 3. Size: 10 pound (4.54 kg).
 - 4. Size and classification as scheduled.
 - 5. Finish: Baked polyester powder coat, red color.
- C. Food Service Kitchen Wet Chemical Fire Extinguisher Type 2A:K: Wet Chemical Type with Pressure Gage, designed specifically for kitchen grease fire hazards.
 - 1. Special potassium acetate based chemical, low PH agent, which leaves no chemical residue to clean up.
 - 2. Capacity: 2.5 gallons.
 - 3. UL Rating: 2A:K.
 - 4. Acceptable Product:
 - a. Larsens, WC 2-1/2.
 - 5. Mounting: Wall Brackets in Food Service Kitchen.

2.04 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.05 MATERIALS:

- A. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - 1. Finish: Baked enamel or powder coat.
 - 2. Color: White.
- B. Stainless Steel: ASTM A 666, Type 304.
 - 1. Finish: No. 4 directional satin finish.

2.06 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames of one-piece construction with edges flanged.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level , 54 inches (1372 mm) from finished floor to top of fire extinguisher or as indicated on Drawings.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 11 4000
FOODSERVICE EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foodservice equipment.
- B. Connections to utilities.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on appliances; indicate configuration, sizes, materials, finishes, locations, and utility service connection locations, service characteristics, and wiring diagrams.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- D. Certificates: Certify that products of this Section meet or exceed specified requirements.
- E. Operation Data: Provide operating data for the specified equipment.
- F. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of standard products of the type specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products clear of floor in a manner to prevent damage.
- B. Coordinate size of access and route to place of installation.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work of this Section within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for replacement or repair of scheduled equipment, refrigerant and compressors, including disconnection and removal of defective unit, and connection of replacement unit.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by FM (AG), ITS (DIR), UL (DIR), or testing agency acceptable to local authorities having jurisdiction as suitable for the purpose specified and indicated.

2.02 EQUIPMENT

- A. Equipment Schedule: As indicated on Drawings.
- B. Installation Accessories: Provide rough-in hardware, supports and connections, attachment devices, closure trim, and accessories as required for complete installation.

2.03 MATERIALS

- A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- B. Stainless Steel Sheet: ASTM A666 Type 304 commercial grade, No. 4 finish.
- C. Finish Hardware: Manufacturer's standard.
- D. Work Surfaces: Stainless steel.
- E. Fittings: Sink drains with crumb cup and waste fittings, faucets, and electrical outlets.
- F. Sealants: _____ type, as specified in Section 07 9005.

2.04 FABRICATION

- A. Install rubber button feet on bearing surface of any item positioned on a finished surface.
- B. Isolate rotating or reciprocating machinery to prevent noise and vibration.
- C. Provide indirect drain piping from equipment to terminate over nearest waste receptor.
- D. Accommodate site installation of other services or equipment.

2.05 FINISHES

- A. Components: Shop finish.
- B. Stainless Steel: No. 4 finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify ventilation outlets, service connections, and supports are correct and in required location.
- B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Insulate to prevent electrolysis between dissimilar metals.
- C. Weld and grind joints in steel work tight, without open seams, where necessary due to limitations of sheet sizes or installation requirements.
- D. Sequence installation and erection to ensure correct mechanical and electrical utility connections are achieved.
- E. Use anchoring devices appropriate for equipment and expected usage.
- F. Provide sealant to achieve clean joint with adjacent building finishes and between abutting components.

3.03 ADJUSTING

- A. Adjust equipment and apparatus to ensure proper working order and conditions.

- B. Remove and replace equipment creating excessive noise or vibration.

3.04 CLEANING

- A. Remove masking or protective covering from stainless steel and other finished surfaces.
- B. Wash and clean equipment.
- C. Polish glass, plastic, hardware, accessories, fixtures, and fittings.

3.05 CLOSEOUT ACTIVITIES

- A. At completion of work, provide qualified and trained personnel to demonstrate operation of each item of equipment and instruct Owner in operating procedures and maintenance.
 - 1. Test equipment prior to demonstration.
 - 2. Individual Performing Demonstration: Fully knowledgeable of all operating and service aspects of equipment.

3.06 PROTECTION

- A. Remove protective coverings from prefinished work.
- B. Protect finished work from damage.

END OF SECTION

**SECTION 11 6813
PLAYGROUND EQUIPMENT**

PART 1 GENERAL

1.01 INCLUDED WORK

- A. All playground equipment indicated on the drawings and/or herein specified, including all footings, anchorages, accessories and play surfaces required to provide complete, safe, and usable play equipment to the satisfaction of the Architect.
- B. Shop prime coat, painting and galvanized finishes for all metal and wood not having factory finishes.
- C. Game and playing lines.
- D. Third Party Certification by a play safety inspector.

1.02 RELATED WORK

- A. Section 32 1816 – Synthetic Resilient Paving
- B. Section 32 1817 – Fibrous Resilient Paving

1.03 REFERENCES AND STANDARDS

- A. Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, American Society for Testing and Materials, ASTM F 1487 & California Assembly Bill 1144.
- B. Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment, ASTM F 1951.
- C. Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment, ASTM F 1292.
- D. Handbook for Public Playground Safety, U.S. Consumer Products Safety Commission (USCPSC).
- E. Manufacturer's printed specifications, instructions, and shop details for installation of the indicated and /or specified play equipment.
- F. All equipment must conform to the Consumer Product Safety Improvement Act of 2016.
- G. California Building Code, Chapter 11B, Accessibility Requirements. Play areas along with number and types of play components shall comply with scoping requirements of CBC Section 11B-240. Play areas with play components and structures provided shall comply with CBC Section 11B-1008.

1.04 QUALITY ASSURANCE

- A. Playground equipment work shall comply with these specifications and all applicable sections of the above-named References and Standards.

1.05 SUBMITTALS

- A. Submit manufacturer's product data, specifications, and installation instructions and shop details for factory fabricated items.
- B. Submit shop drawings. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
 - 1. Plans shall include safety zone and play structures shown within the required play areas as shown on the drawings.
- C. Submit samples of selected colors and finishes.

- D. Submit samples and manufacturer's product specifications for all play surfaces.
- E. Submit playground safety inspection report as submitted by the certified playground safety inspector.
- F. Play equipment shall have an overall average recycled content greater than 20% based on volume or weight, including surface area of immediate play area, not just within the fall zone. Manufacturer to provide documentation as to the recycled content.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle play equipment items to prevent damage and deterioration.
- B. Stack assembled items off the ground.

1.07 PROJECT CONDITIONS

- A. Coordinate play equipment work with trades furnishing adjacent work related to play equipment installation.
- B. Provide sleeves, anchors, inserts, clips, and other items furnished under this Section, and built in with work of other trades.
- C. No work shall be installed until shop drawings for the work have been reviewed and approved in writing by the Architect, and final grading and surfacing is completed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Play Structures:
 - 1. Refer to the drawings for Manufacturers and play equipment and play surfacing model numbers.
 - 2. The use of a manufacturer's name and model number is for purposes of establishing type and quality; other manufacturer's equipment may be submitted for approval by the Architect. Said substitutions must be equal in design, materials, strength, safety, and function to equipment specified.
 - 3. Metal Posts: 4 ½" O.D. Schedule 40 pipe, wall thickness 0.237"; steel tubing of a lesser wall thickness will not be accepted.
 - 4. Wood Decking: 4" thick Douglas Fir, (FOHC) free of heart center, S4S, edges rounded, treated with non-toxic preservative such as Niedox-10.
- B. Concrete: ASTM C94 ready mixed concrete, minimum 28-day compressive strength of 2,500 psi, air-entrained 2% to 4%.
- C. Sand:
 - 1. Approved Sand: 2-16 Amber
 - a. Washed river or beach sand; round particles:

Sieve Size	% Passing
#4	100
#12	100
#16	90
#20	17
#30	2
#100	<1
- D. Line Paint: 100% acrylic latex, non-glare, non-bleeding line paint. Add Skid-Tex ST 30 Non-skid additive to the paint, in proportions of one pound to one gallon of paint.

PART 3 EXECUTION**3.01 INSPECTION**

- A. Examine the substrate under which playground equipment and surfaces are to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide footings, sleeves, and anchorages. Furnish templates, setting drawings, and instructions for installation of sleeves and anchorages built into other work.
- B. Locate and layout all play field markings and equipment items. Obtain the Architect's written approval of the layout prior to installation.

3.03 INSTALLATION

- A. Assemble and install play equipment in accordance with approved shop drawings and manufacturer's printed instructions.
- B. Perform fitting required for installation. Set the work accurately in location, alignment, and elevation free of rack, measured from established lines and levels. Assembled play equipment shall be firm, rigid, free of rattle, and provide maximum protection against tampering and vandalism.
- C. Compact and finish grade the subgrade prior to installing sand and bark play surfaces.
- D. Set equipment at proper relationship to finished play surfacing in accordance with approved shop drawings; provide any hardware necessary to solidly attach equipment to footings, while allowing for the thickness of play surfacing.

3.04 GAME AND PLAY LINES

- A. Clean and prepare surfaces to receive line paint in accordance with the paint manufacturer's specifications.
- B. Accurately locate and mark playing lines by snapping a chalked line on the court surface. Use standard dimensions unless otherwise indicated on the drawings.
- C. Width of lines: As shown on drawings.
- D. Add the skid tex to the paint and stir thoroughly. Let mix soak for at least 30 minutes before applying.
- E. Carefully mask and brush paint the play lines.

3.05 CERTIFICATION

- A. Per California Assembly Bill 1144, a playground safety inspector, certified by the National Playground Safety Institute, is to be attained to conduct an inspection of the installed playground. The resulting inspection report is to be submitted to the Owner at the completion of the project. Owner to pay for third party certification report.

3.06 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair any damage to adjacent work resulting from playground equipment work.
- B. Upon completion of installation, clean factory-finished items in accordance with manufacturer's cleaning instructions. Exercise care to avoid damage to the finish coating.

END OF SECTION

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**SECTION 12 2400
WINDOW SHADES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior manual roller shades.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- B. Sequencing:
 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 2. Do not install shades until final surface finishes and painting are complete.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 2. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
 3. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.
 4. Informational Submittals:
 - a. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
 - b. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- B. Closeout Submittals:
 1. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
 2. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.
 1. Factory training and demonstrated experience.

1.05 MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
 2. Full-sized mock-up may become part of the final installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

- B. Handle and store shades in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 WARRANTY

- A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: Lifetime.
 - 2. Fabric: Lifetime.
 - 3. Aluminum and Steel Coatings: Lifetime.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Interior Manually Operated Roller Shades:
 - 1. MechoShade Systems LLC; Mecho/5 System: www.mechoshade.com.
 - 2. Other Acceptable Manufacturers::
 - a. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com.
 - b. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com.

2.02 ROLLER SHADES

- A. Refer to Finish Schedule for selected products and finishes.
- B. General:
 - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- C. Roller Shades:
 - 1. Interior Roller Shades Room Darkening: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Mounting: Window jamb mounted- inside, between jambs.
 - c. Size: As indicated on drawings.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Stamped steel.
 - 3. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.

4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Manual Operation for Interior Shades:
 - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - b. Drive Chain: Continuous loop beaded ball chain, 95 pounds (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 - c. Chain Retainer:
 - 1) Chain tensioning device complying with WCMA A100.1.
 - 2) Manufacturer's standard clip.
6. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
 - 1) Color: As selected by Architect from manufacturer's standard range.
 - 2) Profile: Square.

2.03 SHADE FABRIC

- A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Light-Filtering Fabric: 3 percent open.
 2. Basis of Design Product:
 - a. MechoShade Systems LLC; EcoVeil Screens - 1350 Series (5% open).
 - 1) Color: Silver Birch.
 3. Material Certificates and Product Disclosures:
 - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
 4. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 5. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 1. Vertical Dimensions: Fill openings from head to sill plus enough fabric for 3 revolutions around roller tube.
 2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch (19.05 mm) total.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3600

COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Specimen warranty.
 - 2. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
 - 3. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- B. Informational Submittals:
 - 1. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
 - 2. Installation Instructions: Manufacturer's installation instructions and recommendations.
 - 3. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 - 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.
 - 2. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 3. A5.406.1, .2 and .3: Materials selected for longevity, reduced maintenance and recyclability.
 - 4. A5.405.4 Recycled content materials, equivalent in performance to virgin materials. Provide cost documentation showing value of recycled content using A5.405.02.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.
- C. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org.
 - 2. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com.

3. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 4. Provide designated labels on shop drawings as required by certification program.
 5. Provide designated labels on installed products as required by certification program.
 6. Replace, repair, or rework all work for which certification is refused.
- D. Installer Qualifications: Fabricator of products, Licensee of WI's Certified Compliance Program
- E. Fabrication and Installation Standards: Fabricate and install in accordance with North American Architectural Woodwork Standards – 3.0 as listed below.
1. Countertops: Section 11.
- F. Woodwork Institute (WI) Certification:
1. Millwork, casework and cabinetwork shall be manufactured in accordance with standards established in the Architectural Woodwork Standards, Latest Edition, published jointly by the Woodwork Institute, Architectural Woodwork Institute, and the Architectural Woodwork Manufacturer's Association of Canada, in grade or grades herein specified or as shown on Drawings.
 2. Before delivery to jobsite, woodwork supplier shall submit Woodwork Institute Certified Compliance Certificate indicating millwork products being supplied and certifying that products fully meet the requirements of Grade or Grades specified.
 3. At completion of installation, woodwork installer shall provide Woodwork Institute Certified Compliance Certificate indicating the products installed, and Certifying that the installation of these products fully meets the requirements of the Grade or Grades specified.
 4. All fees charged by the Woodwork Institute for their Certified Compliance program are responsibility of millwork manufacturer and/or installer and shall be included in their bid.
 5. The foregoing shall not be construed to limit power and authority of Owner to reject any millwork which does not in Owner's opinion meet with any one or more of the specifications of this Contract.

1.05 MOCK-UPS

- A. Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mock-ups of typical countertops as indicated on Drawings.
 2. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 deg F (15.5 deg C) and 90 degrees F (32 degrees C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- C. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.
- D. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on

Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Refer to Finish Schedule for selected products and locations.
- B. Quality Standard: Premium Grade, in accordance with AWMAC/WI (NAAWS) , unless noted otherwise.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - b. NSF approved for food contact.
 3. Exposed Edge Treatment: As indicated on Drawings.
 4. Back Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
 5. Fabricate in accordance with AWMAC/WI (NAAWS) , Section 11 - Countertops, Premium Grade.

2.02 ACCESSORY MATERIALS

- A. Wood-Based Components:
 1. Regional Materials: Wood products shall be manufactured within 100 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.
 2. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
 3. Wood fabricated from old growth timber is not permitted.
 4. Provide sustainably harvested wood, certified or labeled; see Section 01 6000 - Product Requirements.
 5. Provide wood harvested within a 500 mile (805 km) radius of the project site.
 6. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 1. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
 2. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
 3. Softwood Plywood: DOC PS 1.
- C. Composite wood products within the weatherproofing membrane must be documented to have low formaldehyde emissions that meet the California Air Resources Board ATCM for

formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins (NAUF).

- D. Documentation: manufacturer documentation which confirms low formaldehyde emissions that meet the California Air Resources Board Composite Wood Products Airborne Toxic Control Measures (ATCM) for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins (NAUF).
- E. Joint Sealant: As specified in Section 07 9200 - Joint Sealants.
- F. Grommets for Cable Passage: Standard plastic or painted metal, 2 inch (51 mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Color: Black.
- G. Counter Support Brackets:
 - 1. Basis of Design Product:
 - a. Rangine Corporation; Rakks Model EH-1818-FM welded aluminum brackets.
 - 1) Concealed Flush Mounting: White powder coated.
 - 2) Faceplate Covers: Rakks Model EH-FP22.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height and Location: As indicated on Drawings.
- C. Solid Surfacing: Fabricate tops up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 1. Install backsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 2. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 12 4813
ENTRANCE FLOOR MATS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet mat.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide data indicating properties of walk-off surface, component dimensions.
 2. Samples: Submit two samples, 12 by 12 inch (300 by 300 mm) in size illustrating pattern, color, finish, edging.
- B. Informational Submittals:
 1. Maintenance Data: Include cleaning instructions, stain removal procedures.

1.03 SUSTAINABILITY SUBMITTALS

- A. LEED Submittals: Provide submittals conforming to Section 01 8113 Sustainable Design Requirements.
- B. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 5.504.4.1 Adhesives and sealants.

PART 2 PRODUCTS

2.01 ENTRANCE MATS

- A. Walk-Off Carpet Mat: Specified manufacturer's standard carpet construction, including backing.
 1. Materials:
 - a. Fibers: 100 percent UV resistant polypropylene.
 - b. Backing: Nitrile rubber
 2. Color/Pattern Texture: Square pattern, Charcoal.
 3. Pile Thickness: 1/4 inch (6.35 mm).
 4. Beveled Rubber Border: Water Dam Border.
 5. Size: 4 feet by 6 feet.
 6. Basis of Design Product:
 - a. Construction Specialties, Watershield 24 oz Mat.
 - b. Approved equal.

2.02 ACCESSORIES

- A. Adhesives: Manufacturer's recommended adhesive.
 1. LEED Requirements - LEED Credit EQc4.1 - Adhesives shall meet low VOC content as determined by LEED requirements.
 - a. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
 - b. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
 - c. Do not use adhesives that contain urea formaldehyde.
 2. Adhesives: Only use adhesives in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District SCAQMD 1168, CAL-Green Table 5.504.4.1 Adhesive VOC Limit.
 - a. Current requirement refers to the date on which the materials are installed in the building.

- b. A copy of SCAQMD 1168 is referenced in Section 01 8114 - Sustainable Design Requirements - CAL-Green that was current as of the date of this specification. Refer to www.aqmd.gov/rules for the actual current version of the rule that will be applicable at the date of installation during construction.
 3. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
 4. Adhesive: Recommended by carpet tile manufacturer; releasable type.
- B. Miscellaneous Materials: Provide other items recommended by carpet manufacturer and installer for the indicated conditions of carpet use, and as required for complete installation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install walk-off surface after cleaning of finish flooring.

END OF SECTION

**SECTION 14 2400
HYDRAULIC ELEVATORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Complete hydraulic elevator systems.
 - 1. Passenger type.
- B. Elevator Maintenance Contract.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other installers to provide conduits necessary for installation of wiring including but not limited to:
 - a. Elevator equipment devices remote from elevator machine room or hoistway.
 - b. Remote group automatic panel in lobby from controller cabinet.
 - c. To elevator pit for lighting and sump pump.
 - d. Automatic transfer switch from controller cabinet.
 - e. Fire alarm panel from controller cabinet.
 - 2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to, the following:
 - a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
 - b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation.
 - c. Overcurrent protection devices selected to achieve required selective coordination.
- B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
 - 1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
 - 2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.
- C. Construction Use of Elevator: Not permitted.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit data on following items:
 - a. Signal and operating fixtures, operating panels, and indicators.
 - b. Car design, dimensions, layout, and components.
 - c. Car and hoistway door and frame details.
 - d. Electrical characteristics and connection requirements.
 - 2. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
 - a. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
 - b. Hoistway Components: Size and location of car guide rails, buffers, jack unit and other components.
 - c. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
 - d. Clearances and over-travel of car.
 - e. Locations in hoistway and machine room of traveling cables and connections for car lighting and telephone.
 - f. Location and sizes of hoistway and car doors and frames.

- g. Calculated heat dissipation of elevator equipment in machine room.
- h. Applicable seismic design data; certified by a licensed Professional Structural Engineer.
- i. Interface with building security system.
- j. Electrical characteristics and connection requirements.
- k. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
- 3. Samples: Submit samples illustrating car interior finishes, car and hoistway door and frame finishes, and handrail material and finish in the form of samples.
- 4. Testing Agency's Qualification Statement.
- B. Informational Submittals:
 - 1. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Initial Maintenance Contract.
- C. Closeout Submittals:
 - 1. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
 - a. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
 - b. Use form, Draft of Elevator Maintenance Agreement, provided after this section.
- D. Operation and Maintenance Data:
 - 1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
 - 2. Operation and maintenance manual.
 - 3. Schematic drawings of equipment and hydraulic piping, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.04 QUALITY ASSURANCE

- A. Maintain one copy of each quality standard document on site.
- B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- D. Installer Qualifications: Trained personnel and supervisor on staff of elevator equipment manufacturer.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
- F. Products Requiring Fire Resistance Rating: Listed and classified by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Hydraulic Elevators:

AE3 Partners

DSA Application No. 01-119166
September 7, 2021

Increment 1
14 2400 - 2

Merritt College
Child Development Center
HYDRAULIC ELEVATORS

1. Otis Elevator Company; HydroFit 3512: www.otis.com.
2. Other Acceptable Manufacturers:
 - a. KONE Inc.: www.kone.com.
 - b. Mitsubishi Electric; Hydraulic Passenger Elevator: www.mitsubishielevator.com.
 - c. Schindler Elevator Corporation: www.schindler.com.
 - d. ThyssenKrupp Elevator: www.thyssenkruppelevator.com.
 - e. Approved equal.

2.02 HYDRAULIC ELEVATORS

- A. Hydraulic Passenger Elevator:
 1. Hydraulic Elevator Equipment:
 - a. Twin post holeless telescopic 2-stage, above ground.
 2. Drive System:
 - a. Variable voltage variable frequency (VVVF) to modulate motor speed.
 3. Operation Control Type:
 - a. Selective Collective Automatic Operation Control.
 4. Interior Car Height: 96 inch (2438 mm).
 5. Electrical Power: 208 volts; alternating current (AC); three phase; 60 Hz.
 6. Rated Net Capacity: 3500 lbs (1590 kgs).
 7. Rated Speed: 125 ft per minute (0.63 m per second).
 8. Elevator Pit Depth: 48 inch (1219 mm).
 9. Overhead Clearance at Top Floor: As indicated on Drawings.
 10. Travel Distance: As indicated on drawings.
 11. Number of Stops: 2.
 12. Number of Openings: 2 Front.
 13. Hydraulic Equipment Location: As indicated on drawings

2.03 COMPONENTS

- A. Elevator Equipment:
 1. Motors, Hydraulic Equipment, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70. Refer to Division 26.
 2. Guide Rails, Cables, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
 3. Buffers:
 - a. Oil type for elevators with speed greater than 200 feet per minute (1 m per second).
 4. Lubrication Equipment:
- B. Electrical Equipment:
 1. Motors: NEMA MG 1.
 2. Boxes, Conduit, Wiring, and Devices: As required by NFPA 70. Refer to Division 26 - Electrical.
 3. Sump Pump in Pit: Refer to Division 22 - Plumbing.
 4. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
 5. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. Refer to Division 26 - Electrical.

2.04 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards.

- C. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- D. Elevators provided for passengers shall comply with CBC11B-407 and CBC 11B-206.6.
 - 1. Call Controls: Where elevator call buttons or keypads are provided, they shall comply with CBC 11B-407.2.1 and 11B-309.4.
 - a. Height: Call buttons and keypads shall be located within one of the reach ranges specified in CBC 11B-308, measured to the centerline of the highest operable part.
 - 1) The highest operable call button may be 48" A.F.F. on center, per 11B-407.2.1.
 - b. Size and Shape: Call buttons shall have square shoulders, be 3/4 inch minimum in the smallest dimension and shall be raised 1/8 inch plus or minus 1/32 inch above the surrounding surface. The buttons shall be activated by a mechanical motion that is detectable
 - c. Clear floor or ground space - A clear floor or ground space complying with CBC 11B-305 shall be provided at call controls.
 - d. Location: The call button that designates the up direction shall be located above the call button that designates the down direction.
 - e. Signals - Call buttons shall have visible signals that will activate when each call is registered and will extinguish when each call is answered. Call buttons shall be internally illuminated with a white light over the entire surface of the button.
 - f. Keypads - Keypads, where provided, shall be in a standard telephone keypad arrangement and shall comply with CBC 11B-407.4.7.2.
 - 2. Hall signals - Hall signals, including in-car signals, shall comply with CBC 11B-407.2.2.
 - a. Visible and Audible Signals: A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call and the car's direction of travel. Where in-car signals are provided, they shall be visible from the floor area adjacent to the hall call buttons.
 - b. Visible Signals - Visible signal fixtures shall be centered at 72 inches minimum above the finish floor or ground. The visible signal elements shall be a minimum 2-1/2 inches high by 2-1/2 inches wide. Signals shall be visible from the floor area adjacent to the hall call button.
 - c. Audible signals - Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that indicate the direction of elevator car travel. Audible signals shall have a frequency of 1500 Hz maximum. Verbal annunciators shall have a frequency of 300 Hz minimum and 3000 Hz maximum. The audible signal and verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the hall call buttons.
 - 3. Hoistway signs - Signs at elevator hoistways shall comply with CBC 11B-407.2.3.
 - a. Floor designation - Floor designations complying with CBC 11B-703.2 and 11B-103.4.1 shall be provided on both jambs of elevator hoistway entrances. Floor designations shall be provided in both raised characters and Braille. Raised characters shall be 2 inches high. A raised star, placed to the left of the floor designation shall be provided on both jambs at the main entry level. The outside diameter of the star shall be 2 inches and all points shall be of equal length. Raised characters, including the star, shall be white on a black background. Braille complying with 11B-703.3 shall be placed below the corresponding raised characters and the star. The Braille translation for the star shall be "MAIN". Applied plates are acceptable if they are permanently fixed to the jamb.
 - 4. Elevator Door Requirements – CBC 11B-407.3:
 - a. Duration - Door reopening devices shall remain effective for 20 seconds minimum.
 - b. Door and Signal Timing: The minimum acceptable time from notification that a car is answering a call until the doors of that car start to close shall be calculated from the following equation:
 - 1) $T = 0/(1.5 \text{ ft/s})$ or $T = 01(457 \text{ mm/s}) = 5$ seconds minimum where T equals the total time in seconds and D equals the distance {in feet or millimeters) from the point in the lobby or corridor 60 inches directly in front the farthest call button controlling that car to the centerline of its hoistway door.

- c. Door delay - Elevator doors shall remain fully open in response to a car call for 5 seconds minimum.
- 5. Elevator Door Requirements – CBC 11B-407.4:
 - a. Floor Surfaces: Floor surfaces in elevator cars shall comply with CBC 11B-302 and 11B-303.
 - b. Platform to hoistway clearance - The clearance between the car platform sill and the edge of any hoistway landing shall be 1 1/4 inches maximum.
 - c. Leveling - Each car shall be equipped with a self-leveling feature that will automatically bring and maintain the car at floor landings within a tolerance of 1/2 inch under rated loading to zero loading conditions.
 - d. Illumination - The level of illumination at the car controls, platform, car threshold and car landing sill shall be 5 foot candles minimum.
 - e. Provide an obstruction sensor at 5" and 29" A.F.F. complying with CBC 11B-407.3.3.1.
- 6. Elevator car controls - Where provided, they shall comply with CBC 11B-407.4.6 and 11B-309.4.
 - a. Location - Controls shall be located within one of the reach ranges specified in CBC 11B-308.
 - b. Buttons - Car control buttons with floor designations shall comply with the following:
 - 1) Size and Shape - Buttons shall have square shoulders, be 3/4 inch minimum in the smallest dimension and be raised 1/8 inch plus or minus 1/32 inch above the surrounding surface.
 - 2) Arrangement - buttons shall be arranged with numbers in ascending order. When two or more columns of buttons are provided they shall read from left to right.
 - 3) Illumination - Car control buttons shall be illuminated.
 - 4) Operation - Car control buttons shall be activated by a mechanical motion that is detectable.
 - c. Keypads - Car control keypads shall be in a standard telephone keypad arrangement and shall comply with CBC 11B-407.4. 7.2.
 - d. Emergency controls - Emergency controls shall comply with CBC 11B-407.4.6.4.
 - 1) Height - Emergency control buttons shall have their centerlines 35 inches minimum above the finish floor.
 - 2) Location - Emergency controls, including the emergency alarm, shall be grouped at the bottom of the panel.
- 7. Designations and Indicators of Car Controls: Comply with CBC 11B-407.4. 7.
 - a. Buttons - Car control buttons shall comply with CB 11B-407.4.7.1.
 - 1) Type - Control buttons shall be identified by raised characters or symbols, white on a black background, complying with CBC 11B-703.2 and Braille complying with 11B-703.3.
 - 2) Location - Raised characters or symbols and Braille designations shall be placed immediately to the left of the control button to which the designations apply.
 - 3) Symbols - The control button for the emergency stop, alarm, door open, door close, main entry floor, and phone, shall be identified with raised symbols and Braille as shown in Table 11B-407.4.7.1.3.
 - 4) Visible indicators - buttons with floor designations shall be provided with visible indicators to show that a call has been registered. The visible indication shall extinguish when the car arrives at the designated floor.
 - 5) Button spacing - A minimum clear space of 3/8 inch or other suitable means of separation shall be provided between rows of control buttons.
 - b. Keypads : Keypads shall be identified by characters complying with CBC 11B-703.5 and shall be centered on the corresponding keypad button. The number five key shall have a single raised dot. The dot shall be 0.118 inch to 0.120 inch base diameter and in other aspects comply with Table 11B-703.3.1.
- 8. Car Position Indicators: Audible and visible car position indicators shall be provided in elevator cars.
 - a. Visible indicators - Visible indicators shall comply with CBC 11B-407.4.8.1.
 - 1) Size: Characters shall be 1/2 inch high minimum.

- 2) Location: Indicators shall be located above the car control panel or above the door.
- 3) Floor Arrival: As the car passes a floor and when a car stops at a floor served by the elevator the corresponding character shall illuminate
- b. Audible indicators - Audible indicators shall comply with CBC 11B-407.4.8.2.
 - 1) Signal Type: The signal shall be an automatic verbal annunciator which announces the floor at which the car is about to stop.
 - 2) Signal Level: The verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the annunciator.
 - 3) Frequency: The verbal annunciator shall have a frequency of 300 HZ minimum to 3000 HZ maximum.
- 9. Emergency Communication - Emergency two-way communication systems shall comply with CBC 11B-308. Raised symbols or characters, white on black background, and Braille shall be provided adjacent to the device and shall comply with CBC 11B-703.2 and 11B 703.3. Emergency two-way communication systems between elevator and a point outside the hoistway shall comply with ASME A17.1 and CBC 1009.8.
- 10. Support rail - Support rails shall be provided on at least one wall of the car.
 - a. Location - Clearance between support rails and adjacent surfaces shall be 1-1/2 inches minimum. Top of support rails shall be 31 inches minimum to 33 inches maximum above the floor of the car. The ends of the support rail shall be 6 inches maximum from adjacent walls.
 - b. Surfaces: Support rails shall be smooth and any surface adjacent to them shall be free of sharp or abrasive elements.
 - c. Structural Strength: Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds is applied at any point on the support rail, fastener, mounting device, or supporting structure.
- E. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 - 2. Affected peak velocity acceleration (A_v) for Project's location is greater than or equal to 0.20 (seismic risk Zones 3 and 4).
 - 3. Provide earthquake equipment required by ASME A17.1/CSA B44.
 - 4. Provide seismic switch required by ASCE/SEI 7.
- F. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
- G. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
 - 1. Complying with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7 and other related requirements.
 - a. Project Seismic Risk: Zones 3 and 4.
 - 2. Provide earthquake emergency operations in accordance with ASME A17.1 requirements.
- H. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- I. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.
- J. Perform electrical work in accordance with NFPA 70.
- K. Comply with venting or pressurization of hoistway design in accordance with HVAC system requirements and authorities having jurisdiction (AHJ).
- L. Comply with fire protection sprinkler system of hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction (AHJ). Refer to Section 21 1300.

- M. Comply with fire protection sprinkler system of the hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction. Refer to Division 21 - Fire Suppression.

2.05 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 - 1. Pump: Manufacturer's standard, submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts.
 - 2. Motor: Solid-state starting, variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
 - 1. Cylinder units shall be connected with dielectric couplings.
 - 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.
- E. Hydraulic Fluid: Nontoxic, biodegradable, fire-resistant fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives, that is approved by elevator manufacturer for use with elevator equipment.
- F. Car Frame and Platform: Welded steel units.
- G. Guides: Roller guides. Provide guides at top and bottom of car frame.

2.06 OPERATION CONTROLS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Elevator Controls: Provide landing operating panels and landing indicator panels.
 - 1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
 - 2. Landing Indicator Panels: Illuminating.
 - 3. Comply with ADA Standards for elevator controls.
- C. Interconnect elevator control system with building fire alarm, smoke alarm, and building management control systems.
- D. Door Operation Controls:
 - 1. Program door control to open doors automatically when car arrives at floor landing.
 - 2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
 - 3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.
 - 4. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.07 OPERATION CONTROL TYPE

- A. Selective Collective Automatic Operation Control: Applies to car in single elevator shaft.

1. Refer to description provided in ASME A17.1.
 2. Automatic operation by means of one button in the car for each landing served and by "UP" and "DOWN" buttons at the landings.
 3. Stops are registered by momentary actuation of landing car buttons without consideration of the number of buttons actuated or the sequence buttons are actuated, but the stops are made in the order that landings are reached in each direction of travel.
 4. All "UP" landing calls are made when car is traveling in the up direction.
 5. All "DOWN" landing calls are made when car is traveling in the down direction.
 6. Uppermost and lowermost calls are answered as soon as they are reached without consideration of the car travel direction.
- B. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

2.08 EMERGENCY POWER

- A. Elevator Emergency Power Supply: Supplied by battery backup; provide elevator system components as required for emergency power characteristics.
1. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the ground floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
- B. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
- C. Provide operational control circuitry for adapting the change from normal to emergency power.

2.09 MATERIALS

- A. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel), with matte finish.
- C. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- D. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
- E. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- F. Flooring: As indicated in Finish Schedule.

2.10 CAR AND HOISTWAY ENTRANCES

- A. Elevator:
1. Car and Hoistway Entrances:
 - a. Hoistway Fire Rating: As indicated on drawings.
 - b. Framed Opening Finish and Material: Brushed stainless steel.
 - c. Car Door Material: Stainless steel, with rigid sandwich panel construction.
 - d. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.
 - e. Door Operation: Side opening, two speed.
- B. Integrated Control System: Mount elevator controller hoistway entrance above first floor landing. Design to accommodate control system and provide access to critical electrical components and troubleshooting features.
- C. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
- D. Door Hanger and Tracks: Provide sheave type two-point suspension hangers and tracks for each hoistway horizontal sliding door.

1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
- E. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves
- F. Sills/Thresholds: Configure to align with frame return and coordinate with floor finish.
- G. Gasketing: Provide acoustic type gasketing at hoistway doors and frames to eliminate audible noise due to car activities in the hoistway, and air pressure differential between hoistway and landing floors.

2.11 CAR EQUIPMENT AND MATERIALS

- A. Elevator Car:
1. Car Operating Panel: Provide main; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons and alarm button.
 - a. Panel Material: Integral with front return; one per car.
 - b. Car Floor Position Indicator: Above door with illuminating position indicators.
 - c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch (1.372 m) above car finished floor.
 - d. Provide matching service cabinet integral with front return panel, with hinged door and keyed lock in each car.
 - e. Provide following within service cabinet as part of car operating panel:
 - 1) Switch for each auxiliary operational control, keyed.
 - 2) Switches for fan, light, and inspection control.
 - 3) Emergency light.
 - 4) Telephone cabinet and hard-wired connection with telephone.
 - 5) Control for each other special feature specified.
 - 6) Convenience outlet receptacle; 110 VAC, 15 amps.
 2. Flooring: Terrazzo.
 3. Wall Base: Recessed stainless steel, 4 inch (102 mm) high.
 4. Front Return Panel: Match material of car door.
 5. Door Wall: Stainless steel.
 6. Side Walls: 5WL Rigidized stainless steel , satin finish.
 - a. Two panels with reveals.
 7. Rear Wall: 5WL Rigidized stainless steel satin finish.
 - a. Three panels with reveals.
 8. Hand Rail: Stainless steel, at all three sides. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall. satin finish.
 - a. Round, Metal Tube: 1-1/2 inch (38 mm) diameter.
 - b. Stainless Steel Finish: No. 4 Brushed.
 9. Ceiling:
 - a. Canopy Ceiling: Stainless steel.
 - 1) Downlight type, metal pans with suspended LED downlights.
 - b. Lighting: LED perimeter-lit ceiling (FC-10), black.
- B. Car Accessories:
1. Certificate Frame: Stainless steel frame glazed with tempered glass, and attached with tamper-proof screws.
 2. Protective Pads: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for each elevator.
 - a. Color: As selected by Architect.
 - b. Provide at least 4 inch (102 mm) clearance from bottom of pad to finished floor.
 - c. Pad Supports: Stainless steel studs, and mounted from ceiling frame.

2.12 SIGNAL EQUIPMENT

- A. General: Provide hall-call buttons that light when activated and remain lit until call has been fulfilled. Provide buttons and lighted elements illuminated with LEDs.
- B. Hall Push-Button Stations: Provide one hall push-button station at each landing, vandal resistant, blue, SS, 1/8 inch projecting.
 - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
 - 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 27.
 - 4. Phase 1 firefighter's service key switch, with instructions, incorporated into hall station at Ground Floor.
- C. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide the following:
 - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 - 2. Hall Position Indicators: Provide illuminated, with arrow indication of travel, located above each hoistway entrance at ground floor.
- D. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- E. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.
 - 1. Incorporate ASME A17.1 appendix H in hall station.
- F. Hall Access Key: Mount within 12 inches of hall call station.

2.13 DOOR OPERATION

- A. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
- B. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
- C. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.
- D. Limited Door Reversal: If the doors are closing and the infrared beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
- E. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
- F. Door Close Watchdog: If doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
- G. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

- H. Door Protection Devices: Infrared light beams project across car opening detecting presence of passenger or object. If door movement is obstructed, doors shall immediately reopen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that hoistway, pit, and machine room are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components, and comply with requirements of Section 01 5000 - Temporary Facilities and Controls.
- B. Excavate for in-ground hydraulic cylinder casing and remove subsoil from site.
- C. Maintain in-ground shaft alignment of 1/2 inch (12.7 mm) maximum from plumb.
 - 1. Fill over-excavated shaft depth with lean concrete.
- D. Maintain elevator pit excavation free of water.
- E. Place in-ground plunger casing full depth of shaft. Align to 1/4 inch (6.4 mm) from plumb. Cut top of casing at hoistway pit slab elevation.

3.03 INSTALLATION

- A. Coordinate this work with installation of hoistway wall construction.
- B. Install system components, and connect equipment to building utilities.
- C. Provide conduit, electrical boxes, wiring, and accessories in accordance with Division 26 - Electrical.
- D. Install hydraulic piping between cylinder and pump unit.
- E. Mount machines, motors, and pumps on vibration and acoustic isolators, on bed plate and concrete pad.
 - 1. Securely fasten to building supports.
 - 2. Prevent lateral displacement.
- F. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
- G. Install guide rails to allow for thermal expansion and contraction movement of guide rails.
- H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
- I. Bolt or weld brackets directly to structural steel hoistway framing.
- J. Field Welds: Chip and clean away oxidation and residue with wire brush; spot prime surface with two coats.
- K. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

- L. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- M. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
- N. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
- O. Adjust equipment for smooth and quiet operation.

3.04 TOLERANCES

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
- B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI-1 will be performed at their discretion.
 - 1. Schedule tests with agencies and notify Owner and Architect.
 - 2. Obtain permits as required to perform tests.
 - 3. Document regulatory agency tests and inspections in accordance with requirements.
 - 4. Perform tests required by regulatory agencies.
 - 5. Furnish test and approval certificates issued by authorities having jurisdiction.
- C. Perform testing and inspection in accordance with requirements.
 - 1. Inspectors shall be certified in accordance with ASME QEI-1.
 - 2. Perform tests as required by ASME A17.2.
 - 3. Provide at least two weeks written notice of date and time of tests and inspections.
 - 4. Supply instruments and execute specific tests.

3.06 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
- B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch (6.4 mm) maximum from flush with sill.

3.07 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components in accordance with manufacturers written instructions.

3.08 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, cleaning and maintenance of each component.
- C. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.

4. Location: At project site, unless noted otherwise.

3.09 PROTECTION

- A. Do not permit construction traffic within car after cleaning.
- B. Protect installed products until Date of Substantial Completion.
- C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

3.10 MAINTENANCE

- A. Refer to Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to initial maintenance service.
- B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 12 months from Date of Substantial Completion.
- C. Submit proposal for continuation of Maintenance Contract in accordance with ASME A17.1 and requirements as indicated for installed elevator equipment.
- D. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.
- E. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
- F. Examine system components periodically.
- G. Include systematic examination, adjustment, and lubrication of elevator equipment.
- H. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
- I. Perform work without removing cars from use during peak traffic periods.
- J. Provide emergency call back service on overtime throughout period of this maintenance contract.
- K. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION

**SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, fittings, valves, and connections for fire protection systems.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Preparation and painting of fire protection piping systems.
- B. Section 21 13 00 - Fire-Suppression Sprinklers
- C. Section 22 05 01 - Plumbing Requirements

1.03 REFERENCE STANDARDS

- A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2010.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2010.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers; 2011.
- D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 2011.
- E. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers; 2007.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2010.
- H. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013.
- I. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.
- J. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- K. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUMMARY

- A. Fire protection system shall be designed and built/installed by the same subcontractor. Subcontractor shall provide design and submittals as listed in the specification. Fire protection design shall meet 2013 California Fire Code requirement and the requirements of this specification.

1.05 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Wet-Pipe Sprinkler System: Provide a hydraulically calculated automatic wet sprinkler system throughout the entire building, designed and installed in accordance with NFPA 13.

1.06 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- C. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq.ft. over 1500 sq. ft..
 - 4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft..
 - b. Storage Areas: 130 sq. ft..
 - c. Mechanical Equipment Rooms: 130 sq. ft..
 - d. Electrical Equipment Rooms: 130 sq. ft..
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

1.07 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers catalogue information for each product indicated. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Field test reports and certificates.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Conform to UL and FM requirements.
- C. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- D. Products Requiring Electrical Connection: UL Listed and classified as suitable for the purpose specified and indicated.

- E. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems. Base calculations on results of fire-hydrant flow test.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a C-16 Licensed Contractor.
- F. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products from one of the manufacturers specified. Similar products shall be from the same manufacturer only, mix and matching shall not be allowed.

2.02 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Conform work to NFPA 13.
- B. Welding Materials and Procedures: Conform to ASME Code.

2.03 BURIED PIPING AND COMPONENTS

- A. Steel Pipe: ASTM A 53/A 53M Schedule 40 or ASTM A 795 Standard Weight, black, with AWWA C105 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded; with double layer, half-lapped polyethylene tape.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
 - 3. Joints: Welded in accordance with AWS D1.1.
 - 4. Casing: Closed glass cell insulation.
- B. Piping from a point 12 inches above the floor to a point 5 feet outside the building wall (minimum) shall be composed of a single extended 90 degree fitting (In-Building Riser) of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a grooved end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. The grooved end shall include a coupler and cap to facilitate testing of the underground piping. The In-Building riser shall be Zurn Wilkins Model WBR or approved equal. Piping more than 5 feet outside the building wall shall comply with Division 33 "Water Distribution for Domestic and Fire Protection Service".

2.04 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A 795 Schedule 10 or ASTM A 53 Schedule 40, black.
 - 1. Steel Fittings: ASME B16.9, wrought steel.

2. Malleable Iron Fittings: ASME B16.3, threaded fittings.
3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
4. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.05 PIPE HANGERS AND SUPPORTS

- A. Per NFPA 13.

2.06 GATE VALVES

- A. Up to and including 2 inches:
 1. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- B. Over 2 inches:
 1. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged or grooved ends.
- C. Over 4 inches:
 1. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

2.07 GLOBE OR ANGLE VALVES

- A. Up to and including 2 inches:
 1. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
- B. Over 2 inches:
 1. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.08 BALL VALVES

- A. Up to and including 2 inches:
 1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
- B. Over 2 inches:
 1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged.

2.09 BUTTERFLY VALVES

- A. Bronze Body:
 1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
- B. Cast or Ductile Iron Body
 1. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

2.10 CHECK VALVES

- A. Up to and including 2 inches:

1. Bronze body and swing disc, rubber seat, threaded ends.
- B. Over 2 inches:
 1. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
- C. 4 inches and Over:
 1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.11 DRAIN VALVES

- A. Compression Stop:
 1. Bronze with hose thread nipple and cap.
- B. Ball Valve:
 1. Brass with cap and chain, 3/4 inch hose thread.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipes passing through partitions, walls, and floors.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Pipe Hangers and Supports:
 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 2. Place hangers within 12 inches of each horizontal elbow.
 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 6. Provide copper plated hangers and supports for copper piping.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.

- J. Do not penetrate building structural members unless indicated.
- K. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- L. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- M. Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.03 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
- C. Underground Service-Entrance Piping: Ductile-iron, push-on-joint pipe and fittings and restrained joints.

3.04 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. NPS 1-1/2 and Smaller: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- B. NPS 1-1/2 and Smaller: Plain-end, black, standard-weight steel pipe; locking-lug fittings; and twist-locked joints.
- C. NPS 2 and Larger: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- D. NPS 2 and Larger: Grooved-end, black, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.05 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - b. Throttling Duty: Use globe valves.

3.06 JOINT CONSTRUCTION

- A. Refer to Division 23 for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.

- D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

3.07 PIPING INSTALLATION

- A. Refer to Division 23 for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to Fire Marshal requirements and NFPA 13.
- F. Install sprinkler piping with drains for complete system drainage.
- G. Install alarm devices in piping systems.
- H. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install sprinkler system piping according to NFPA 13.
- I. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
- J. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install such that they will not be subject to freezing.

3.08 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.09 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Concealed or Recessed sprinklers.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive environment.
 - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

- c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
- d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
- e. Sprinkler Finish: Subject to Architect review and approval prior to installation.

3.10 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.
- C. Provide sprinkler guards to protect sprinklers subject to physical damage.

3.11 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire department connections in vertical wall.
- B. Install freestanding-type, fire department connections in level surface.
 - 1. Install protective pipe bollards on two sides of each fire department connection. Refer to Division 5 for pipe bollards.
- C. Install ball drip valve at each check valve for fire department connection.

3.12 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping to components to allow service and maintenance.
- C. Electrical Connections: Power wiring is specified in Division 26 00 00.
- D. Connect alarm devices to fire alarm.

3.13 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 23.

3.14 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 3. Coordinate with fire alarm tests. Operate as required.
 - 4. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION

**SECTION 21 1300
FIRE SUPPRESSION SPRINKLERS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.02 RELATED REQUIREMENTS

- A. Section 21 05 00 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.
- B. Section 22 05 01 - Plumbing Requirements.
- C. Section 28 31 00 - Fire Detection and Alarm.
- D. Low Voltage Wire and Cable.
- E. Wiring Devices.

1.03 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.
- C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2012.
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2012.
- F. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013.
- G. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for each product indicated including sprinklers, valves, and specialties, including manufacturer's catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
 - 3. Submit coordinated shop drawings, product data, and hydraulic calculations to Architect and Authority Having Jurisdiction for approval. Submit proof of approval to Architect.
- D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of Project.
 - 1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
 - 2. Sprinkler Wrenches: For each sprinkler type.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL requirements.
- C. Designer Qualifications: System shall be designed by a C-16 licensed Fire Sprinkler Contractor, experienced in design of this type of work and licensed in the State of California.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Equipment and Components: Provide products that bear UL and/or FM label or marking.
- F. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Tyco Fire Products: www.tyco-fire.com.
 - 2. Viking Corporation: www.vikinggroupinc.com.
 - 3. Grinnell Fire Protection: www.grinnell.com
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide complete coverage for entire building.
- B. Occupancy: Ordinary hazard, Group 1; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from current water flow test data.
- D. Interface system with fire alarm system.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

2.03 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Sprinkler finish subject to Architect review and approval prior to installation.
- C. Suspended Ceiling Type: Concealed pendant type with matching push on escutcheon plate or recessed heads.

1. Finish: Chrome plated.
 2. Escutcheon Plate Finish: Enamel, color as selected.
 3. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- D. Exposed Area Type: Standard upright type.
1. Finish: Brass.
 2. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- E. Sidewall Type: Standard horizontal sidewall type with matching push on escutcheon plate.
1. Finish: Chrome plated.
 2. Escutcheon Plate Finish: Enamel, color as selected.
 3. Fusible Link: Glass bulb type temperature rated for specific area hazard.

2.04 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.
- C. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- E. Fire Department Connections:
1. Type: Flush mounted wall type with brass finish.
 2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 3. Drain: 3/4 inch automatic drip, outside.
 4. Label: "Sprinkler - Fire Department Connection".
- F. Supervisory Switches: As manufactured by Potter Electric.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install components in accordance with manufacturer's instructions.
- C. Coordinate alarm gong location with Fire Marshal and Architect.
- D. Route pipe runs to minimize obstruction to other work.
- E. Route piping in concealed spaces above finished ceilings.
- F. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- G. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- H. Flush entire piping system of foreign matter.
- I. Install fire pump system, per NFPA and manufacturer requirements.
- J. Hydrostatically test entire system.
- K. Testing shall be witnessed by Fire Marshal.

END OF SECTION

**SECTION 22 0000
PLUMBING GENERAL REQUIREMENTS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 01.
- B. The requirements of the General Conditions and Supplementary Conditions.

1.02 SUMMARY

- A. Furnish and install a complete (fully tested, adjusted, and ready for operation) plumbing system as described by the Contract Drawings and Specifications.
- B. The design described in the Project documents reflect a building designed for low consumption of energy and water and minimum environmental footprint. Any modifications to the systems described herein shall maintain or improve on the sustainability and energy efficiency features of the project.
- C. All design modifications that pertain to system selection, system energy efficiency, water and energy use, material selection and indoor air quality issues shall require the approval of Integral Group.
- D. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
- E. Check, verify, and coordinate Work with Contract Drawings and Specifications prepared by all other trades. Include modifications, relocations, and adjustments necessary to complete work or avoid interference with other trades.
- F. Where architectural features govern location of Work, refer to Architectural Drawings.
- G. Contractor may install additional piping, fittings, and valves, not shown on the drawings, for testing purposes or convenience of installation. Where such materials are installed, they shall comply with the specifications and shall be properly sized for the system and operation. Remove such installed materials when they interfere with design conditions or as directed by the Architect.
- H. LEED: This building shall be LEED certified. Contractor and their subs shall provide all relevant support documentation pertaining to the LEED credits that relate to their work.
- I. Commissioning: The scope of work for the Contractor shall not include the duties of the Commissioning Authority (CxA). Contractor will be required, however, to include in their scope of work duties relevant to the commissioning process, including but not limited to training of owner's personnel in the operation of the plumbing equipment, providing manufacturer's startup and pre functional checklists and contractor-provided pre-functional and startup checklists to Commissioning Authority, performing and documenting pre-functional tests for plumbing equipment, performing and documenting functional tests for plumbing equipment, supporting DDC Contractor and Test and Balance Contractor in the performance of their duties, and providing operations and maintenance manuals. Refer to Division 23 "Commissioning of HVAC and Plumbing" for additional requirements.

1.03 CODES AND STANDARDS

- A. All work and materials shall be in full accordance with the latest local rules and regulations, applicable sections of the California Code of Regulations, Title 24, State Fire Marshal, the Safety Orders of the Division of Industrial Safety, the California Electric Code and applicable

State requirements. Nothing in these Plans and Specifications is to be construed to permit work not conforming to these requirements.

- B. Wherever the Specifications call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these Specifications shall govern. Should there be any direct conflict between the above rules and regulations and the Specifications the rules shall govern.
- C. Equipment shall have UL label listing.

1.04 DRAWINGS

- A. Layout of the equipment and work is diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. Any interference noted between different drawings, and between drawings and actual field conditions shall be brought to the attention of the Architect and Engineer of Record for a decision. The right is reserved to make any reasonable change in location of equipment without additional expense to the Owner.
- B. For purposes of clarity and legibility, drawings are diagrammatic to the extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping and locations of equipment shall be governed by structural conditions and obstructions. Contractor shall make use of all data in Contract Drawings and Specifications and field conditions.
- C. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, shop drawings of the proposed rearrangement. Because of the diagrammatic nature and small scale of the Contract Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the structural and finish conditions affecting all the Work and shall arrange such Work accordingly, furnishing such fittings, equipment, accessories, etc., as may be required to meet such conditions, at no increase in Contract Sum.
- D. The construction documents for this project were prepared by the design team using BIM (Building Information Modeling). Using this software by the design team does not relieve the Contractor from performing the necessary coordination to provide complete, code compliant and operational building systems. The plans and sections provided are diagrammatic and show the design intent, these are not intended to be used for fabrication or installation. Contractor is responsible for generating shop drawings for fabrication that meet the design intent as shown on the Contract Documents. The exact location of the piping, electrical and support components are to be determined by the Contractor. All building sections and details provided are for information only and do not relieve the Contractor from performing final coordination. Contractor is responsible for coordinating with all other trades.
- E. All dimensions and locations of equipment, doors, partitions, etc., are to be taken from the architectural plans but shall be verified at the site.

1.05 SUBMITTALS

- A. See Division 01 “Administrative Requirements”, for submittal procedures.
- B. Plumbing and related submittals are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.
- C. Engineer of Record will review submittals and provide comments within the following timeframe after receipt by the Engineer:
 - 1. For typical submittals, allow 10 working days.
 - 2. For large or complex submittals, allow 15 working days. Determination of “large and complex” submittal shall be at the discretion of the Engineer of Record.

3. Do not send Engineer of Record more than 10 submittals in a contiguous period of 5 working days. If excess submittals are received, review period will be extended as necessary to perform proper review. Submittals will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.
 4. These submittal review periods supersede and take precedence over periods defined in Division 01, unless Division 01 allows for longer review periods.
 5. Submittal review periods shall not be reduced from the times herein except by agreement with the reviewing entity, in advance and in writing.
- D. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Use the same identifiers (e.g. equipment tags) used in Contract Drawings.
- E. Submittals shall be provided in digital format.
1. Provide a separate file for each submittal. For submittal packages, provide a separate file for each subsection (e.g. hardware cutsheets and shop drawings for the same Section shall be provided as separate files).
 2. Product cutsheets, test forms and other text documents shall be provided in word searchable digital format. Acceptable formats are MS Word, PDF (generated from another electronic document and word-searchable; scans of paper documents are not acceptable), and HTML; other formats require approval prior to submission.
 3. Drawings and schematics shall be provided in PDF format and in AutoCAD compatible format.
 4. Scanned paper documents are not acceptable
 - a. Exception: original signed documents, such as qualifications, inspection certificates, and warranty documents.
 5. Hardcopy (paper) submittals are not acceptable and shall not be provided except as noted in Article 1.02).
 6. Submittals provided in the wrong format will be returned without action.
- F. Submission and Resubmission Procedure
1. Optional Pre-Submittals: At Contractor's option, material may be submitted unofficially via email directly to the Engineer of Record for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time, and to provide a venue to discuss technologies, products, designs or implementation strategies that are novel or unique.
 2. Each submittal shall have a unique serial number that includes the associated Specification Section followed by a number for each sub-part of the submittal for that Specification Section, such as SUBMITTAL 22 00 00-01. There is no requirement to assign particular serial numbers to any specific submittals – serial number assignment is arbitrary. The only requirements are that the serial numbers be sequential (to avoid confusing gaps) and, most importantly, consistent across all submittal correspondence.
 3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 22 00 00-01 REVISION 1.
 4. Submit one copy of submittal in electronic format specified in Paragraph 1.05E. Submissions made in the wrong format will be returned without action.
 5. Include with each submittal and resubmittal a copy of the relevant specification section(s) noting on each paragraph and sub-paragraph(s) the following:
 - a. CONFORMS: Contractor has verified that the submitted product conforms to the noted requirement(s).
 - b. CONFORMS AS NOTED: Contractor has verified that the submitted product conforms to the noted requirement(s) by means of being equal to or higher quality and / or performance.

- c. NON-CONFORM: Contractor has verified that the submitted product does not conform to the noted requirement(s) and delineates each deviation from the specification requirements.
 - d. NOT APPLICABLE: Contractor has verified that the noted requirement(s), in their opinion do not apply to this product, delineating the reasons for this decision.
 - e. Include with each submittal and resubmittal a copy of the relevant specification section(s) the printed name of the contractor reviewer, their signature, the company name, and date of review.
6. Revise submittal
- a. Respond to all comments:
 - 1) Revise initial submittal to resolve review comments and corrections.
 - 2) Provide complete responses to comments or suggestions which are not practical to implement in the opinion of the Contractor.
 - b. Indicate any changes that have been made other than those requested.
 - c. Clearly identify resubmittal by original submittal number and revision number.
 - d. Resubmittals that are not responsive to all comments will be returned without action.
7. Resubmit revised submittals until no exceptions are taken.
8. Once submittals are accepted with “No Exceptions Taken” or “Approved as Noted”, provide:
- a. Complete submittal of all accepted drawings and products in a single electronic file.
 - b. Copies for coordination with other trades, if and as required by the General Contractor or Owner’s Representative.
- G. Submit shop drawings, a list of proposed material and equipment manufacturers and the names of Subcontractors.
- H. Shop drawings shall be provided for all plumbing systems for all floors of the building. Plumbing shop drawings shall also be provided for the underslab systems (under the foundation slab) and slab-embedded systems such as floor drains.
- I. Materials and methods with which the words “for approval” or “approved” are used, and materials and methods which differ from those specified, shall be submitted.
- J. Prepare and submit shop drawings, sections, details and diagrams to minimum scale 1/4-inch = 1-foot-0-inches. Drawings shall be coordinated, dimensioned and indicate equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers, etc. Electronic submittal is encouraged.
- K. Submit manufacturer’s specifications, product source, data sheets, certified equipment drawings and installation instructions, including installation dimensions, clearances, weights, materials, finishes, color selection, accessories, acoustical characteristics, capacity and full load and part load performance curves; complete with electrical data, motor horse power, kW; motor efficiency, amperage, voltage phases and wiring diagrams. Identify the particular specification section number, paragraph and equipment identification number per equipment schedule. Note that suppliers (wholesalers and distributors) data sheets are not acceptable unless they are also manufacturers of the product being submitted.
- L. Pump systems, with equipment in parallel, shall have performance curves noting single equipment operation and all iterations of additional equipment.
- M. Certified Equipment Drawings (8-1/2 inch x 11 inch sheets) shall be indexed in accordance with Specification Section. Drawings to be submitted at a later date shall be marked with a page as a placeholder for insertion when submitted. The original submittal shall note which shop drawings will be submitted later. Marked-up catalogs are not acceptable and will be returned without action. Electronic submittal is required.

- N. Engineer of Record's review of submittals is for limited purpose of verifying conformance with information given and design concept expressed in Contract Drawings and Specifications. Engineer's review is not for purpose of determining accuracy or completeness of items such as dimensions and quantities, which remain responsibility of Contractor.
- O. Contractor shall not commence with fabrication or installation of any equipment or system until the associated submittals have been approved by the Engineer of Record and returned with "no exceptions" taken. Contractor shall be solely liable for any costs incurred from starting fabrication before approved submittals are returned.
- P. All final approved submittals and equipment datasheets shall be provided, in PDF format, to the owner as part of the as-built drawing set and shall be text searchable.

1.06 COORDINATION DRAWINGS

- A. Utilize the latest version of 3D AutoCAD, Navisworks, and/or Revit software for the Coordination Drawings. No proprietary software of any kind shall be used other than that indicated. Drawing paper size shall not be larger than FULL SIZED Contract Drawings, and in no case larger than 30 inches x 42 inches. Coordinate available space with ALL other trades involved.
- B. Provide Coordination Drawings in digital electronic format. Provide both native file format (AutoCAD, Navisworks, or Revit) and PDF format files. Hardcopy drawings are not acceptable.
- C. These drawings are to show pipe sizes, valves and accessories, elevation of bottom of pipe, all elevations of materials and/or systems throughout each floor inclusive of hanger components, seismic bracing if applicable, and any component of construction that impacts vertical and/or horizontal space. In addition, the locations of all valves and other items requiring access for service and maintenance are to be shown. The drawings are to also show electrical, structural beams, architectural bracing, structural bracing, ceiling heights, access doors, walls, floor to floor dimensions, columns, doors and other major architectural and structural features as shown on the architectural and structural drawings. Where the routing of work differs from that indicated on the Contract Drawings, such areas are to be indicated by highlighting with a note describing the reason for the change.
- D. Rerouting of any system or part thereof shall be submitted separately in order to obtain concurrence of the Engineer of Record. Submitted rerouting must include fully documented proposed solutions with all trades coordinated. Contractor is fully responsible for coordination of systems included herein. Any effort by Engineer of Record beyond answering Contractor's questions will be at Contractor's expense, including attending coordination meetings, review of interim plans, or review of incomplete questions (routing issues without suggested solutions).
- E. The Contractor and subcontractors are responsible to review and resolve any real or apparent interferences or conflicts as indicated by the coordination drawings produced by each trade.
- F. After all conflicts or interferences are resolved, develop a final composite drawing showing the agreed upon routing, layout and juxtaposition of all piping, major conduit, valves, panels, lighting fixtures and all other major mechanical, plumbing and electrical installations. In the preparation of all the final Coordination Drawings, large scale details as well as cross and longitudinal sections are required to fully delineate all conditions.
- G. Submit the Coordination Drawings as digital electronic files to Engineer of Record for review and comment, as indicated under "Shop Drawings" above. Coordination Drawings shall be digitally signed-off by all other trades.
- H. Contractor shall not commence with fabrication or installation of any equipment or system until the associated shop drawings have been reviewed and returned by the Engineer of Record. Engineer's review of shop drawings shall not be taken as approval of their contents. Contractor shall be solely liable for any costs incurred due to deviations from the Contract Drawings.

- I. No extra compensation will be paid for relocating any pipe, duct, conduit, or other material that has been installed without proper coordination between all trades involved. If any improperly coordinated work or installed work that is not in accordance with the approved coordination composites or is specifically noted by the Architect or Engineer of Record for a valid reason, necessitates additional work by the other trades, the costs of all such additional work is to be borne solely by the Contractor.
- J. All changes in the scope of work due to revisions formally issued and approved are to be shown on both the individual subcontractor's Shop Drawings and the Coordination Drawings.

1.07 REQUESTS FOR INTERPRETATION AND CLARIFICATION

- A. See Division 01 "Project Management", for RFI procedures and forms.
- B. Plumbing RFIs are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.
- C. Limit each RFI to a single issue or group of related issues.
- D. Each RFI shall include a workable no-cost or lowest cost solution recommendation by Contractor.
- E. Allow three (3) working days from time of RFI receipt by Engineer of Record for review and response.
- F. Do not send Engineer of Record more than 10 RFIs in a contiguous period of 5 working days. If excess RFIs are received, review period will be extended as necessary to provide a professional response. RFIs will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.

1.08 MATERIALS AND SUBSTITUTIONS

- A. Comply with Division 01 "Product Requirements".
- B. Requests for product or equipment substitution shall be accompanied by a marked up copy of the Engineer of Record's original specification. For each specified product feature or requirement, Contractor shall note the equivalent feature or attribute of the proposed substitute product or equipment.
- C. Shop drawings of proposed material and equipment that differ from the specified materials and equipment, shall be accompanied by drawings that define changes. These drawings shall show modifications of architectural, plumbing, electrical and mechanical work required by the proposed materials and equipment, such as relocation of flues, drains, revised electrical circuits, relocation of roof or wall penetrations, revised foundations, etc.

1.09 COORDINATION WITH OTHER WORK

- A. Contractor performing Work under this Section shall become thoroughly familiar with the Drawings and Specifications. Contractor shall adjust the Work to conform with the conditions shown on these drawings to provide the best possible assembly of the combined Work.
- B. Obtain necessary information from the other trades regarding location of their work in order that the Work in this Section may be placed in correct position.
- C. The inclusion and proper location of supports, pads, sleepers, openings, anchorages, etc. provided by others is the responsibility of the Contractor under this Section. Cutting and/or boring shall be permitted under this Section only with the written approval of the Architect.
- D. It shall be the Contractor's responsibility to coordinate and have provided by other trades where not covered by the Contractor's scope of work, all electrical wiring and power to equipment,

controls and devices, and any other work from other trades as required to provide fully functioning plumbing systems per the Contract Drawings and Specifications.

1.10 MANUFACTURER’S DIRECTIONS

- A. Manufacturer’s directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Contract Drawings and Specifications.

1.11 PROTECTION OF WORK

- A. Equipment and materials shall be stored on dunnage and remain wrapped at all times until installed.
- B. Duct and piping shall be capped during delivery and storage.
- C. During installation, all installed duct and piping shall be capped and protected at the end of each working day.
- D. Equipment shall be protected from weather and stored in an enclosed, indoor location.
- E. Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

1.12 WORKMANSHIP

- A. Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Architect or Engineer of Record, be removed and replaced in a satisfactory manner, without change in Contract Sum or additional cost to the Owner.

1.13 CLOSING IN UNINSPECTED WORK

- A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect, Engineer of Record, and/or Commissioning Authority.
- B. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the Owner.

1.14 EQUIPMENT ANCHORING

- A. Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes.

1.15 PRELIMINARY OPERATION

- A. Under this section, Contractor shall supervise and direct preliminary operation of systems should the Owner demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses for such preliminary operation will be paid by the Owner. Such preliminary operation or payment shall not be construed as an acceptance of the work.

1.16 CUTTING AND OPENINGS

- A. Comply with Division 01 “Cutting and Patching”.

1.17 “AS-BUILT” DRAWINGS

- A. Comply with Section Division 01 “Project Closeout”.

- B. As-built drawings shall be furnished in an electronic format. Provide in drafting software (AutoCAD or Revit) native format and also in PDF format.

1.18 FINAL INSPECTION

- A. At the time of final inspection, a service representative shall be available to make final adjustments.

1.19 FINAL OPERATION

- A. After acceptance of the installation, instruct the Owner’s Representative in operation and maintenance, for a period of three (3), non-consecutive working days at a time requested by the Owner during the first year of warranty.
- B. At the beginning of the instruction period, deliver to the Owner three (3) copies of a durable binder as described under “Operating Instructions”.

1.20 OPERATING INSTRUCTIONS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these Specifications.
- B. Division 22 shall compile and prepare documentation for all equipment and systems covered in Division 22 and deliver this documentation to the General Contractor for inclusion in the O&M manuals prior to the training of Owner personnel.
- C. Provide a summary of operating sequences (start-up, normal run, and shut-down), and control shop drawings in the main mechanical room.
- D. Provide three (3) complete sets of Operating Instructions. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists. See Article 1.19 “Final Operation”.
- E. Provide a copy of the O&M manuals to the Commissioning Authority for review.

1.21 TRAINING OF OWNER PERSONNEL

- A. The General Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. The Commissioning Authority (CxA) shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
- C. The Plumbing Contractor shall have the following training responsibilities:
 1. Provide the CxA with a training plan two weeks before the planned training.
 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment including, but not limited to, pumps, heaters, controls, water treatment systems, etc.
 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 5. The appropriate trade or manufacturer’s representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. Instruction in the use of equipment controls that are integral to equipment or are provided by the equipment manufacturer. Equipment controls training shall include at least the following:
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system and any interface with security and communication systems.
 - 2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - 3) If system supports trending, all trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will set-up actual trends in the presence of the trainer.
 - 4) Every screen shall be completely discussed, allowing time for questions.
 - 5) Use of keypad or plug-in laptop computer for mobile control access.
 - 6) Use of remote access to the system via phone lines or networks, if applicable.
 - 7) Graphics generation, if applicable.
 - 8) Point database entry and modifications, if applicable
 - i. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.
 - j. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate. A video record of the training session is suggested but not required.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
9. The Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
10. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

1.22 WARRANTY

- A. In accordance with Division 01 Project Closeout requirements, Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.

- B. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship, or finish.
- C. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a minimum period of one (1) year from date of Certificate of Occupancy, or per Division 01, whichever is longer.
- D. Warranty also services including instructions, adjusting, testing, noise, balancing, etc.
- E. For each piece of equipment or device with a manufacturer's warranty in excess of one year, Contractor shall furnish certificate of manufacturer's warranty and contact information for manufacturer's warranty service. Contractor shall also provide a list or table of all equipment with warranties exceeding one (1) year in duration.
- F. Provide new materials, equipment, apparatus, labor and/or service, and support to correct or replace that determined by the Owner to be defective or faulty.
- G. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.
- H. After a period of 90 calendar days from date of acceptance of systems by Owner, provide, at no cost to the Owner, one service mechanic for an 8-hour period over as many working days as required to repair, replace any latent deficiency.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 22 0513

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Duty: Continuous duty at ambient temperature of 140 deg F and at altitude of 3300 feet above sea level.
- C. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- D. Motors for submersible pumps shall be hermetically sealed.
- E. Motors 3/4 HP or greater shall be polyphase unless otherwise indicated.
- F. Minimum Motor Service Factor: 1.15.

2.02 MOTOR ENCLOSURES

- A. Totally Enclosed, Fan Cooled (TEFC) for motors located outdoors or in unconditioned or unventilated indoors areas unless otherwise indicated.
- B. Open Drip proof (ODP) for other cases unless otherwise indicated.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency, as defined in NEMA MG 1.
- C. Polyphase motors shall be suitable for use with Variable-frequency Motor Controllers.
- D. Construction:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes to 1600 volts, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 3. Provide motor shaft grounding ring.
 4. Rotor: Random-wound, squirrel cage.
 5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- E. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.04 SINGLE-PHASE MOTORS

- A. Single-phase motors larger than 1/20 HP shall be Electronically Commutated (ECM) unless not offered by the manufacturer.
- B. Electronically Commutated Motors (ECM)
1. Motor shall be brushless DC type specifically designed for HVAC applications with heavy duty ball bearings and Electronic Commutation. It shall contain internal circuitry that converts single phase power into a DC signal. Speed control is achieved through a 0-10 volt DC control signal input through the pre-wired controls wires.
 2. The motor shall be speed controllable down to 20 percent of full speed and 85 percent efficient at all speeds.
- C. Non-ECM
1. Motors shall be one of the following, to suit starting torque and requirements of specific motor application (listed in order of preference):
 - a. Permanent-split capacitor.
 - b. Capacitor start, capacitor run.
 - c. Capacitor start, inductor run.
 - d. Split phase.
 2. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 3. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 22 0517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Sleeves.
 2. Stack-sleeve fittings.
 3. Sleeve-seal systems.
 4. Sleeve-seal fittings.
 5. Grout.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.02 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Zurn Industries, LLC.
 2. Jay R. Smith Mfg. Co.
 3. Josam Company.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Link-Seal - GPT Industries.
 2. Metraflex Company (The).

3. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel, Plastic or Stainless steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements.

2.04 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. HOLDRITE.
 2. Link-Seal - GPT Industries.
 3. Proco Products.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.02 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, Stack-sleeve fittings
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves Stack-sleeve fittings
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 22 0518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Escutcheons.
 2. Floor plates.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

2.02 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.

- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.02 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

**SECTION 22 0519
METERS AND GAGES FOR PLUMBING PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Filled-system thermometers.
 2. Thermowells.
 3. Dial-type pressure gages.
 4. Gage attachments.
 5. Test plugs.
 6. Test-plug kits.
- B. Related Sections:
 1. Section 22 11 16 "Domestic Water Piping" for water meters inside the building.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Terice, H. O. Co.
 - c. Weiss Instruments, Inc.
 2. Standard: ASME B40.200.
 3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
 4. Element: Bourdon tube or other type of pressure element.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 7. Pointer: Dark-colored metal.
 8. Window: Glass.
 9. Ring: Stainless steel.
 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

2.02 THERMOWELLS

- A. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: CNR.
 4. Material for Use with Steel Piping: CSA.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.03 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Terice, H. O. Co.
 - c. Weiss Instruments, Inc.
 2. Standard: ASME B40.100.
 3. Case: Liquid-filled Sealed Open-front, pressure relief type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 8. Pointer: Dark-colored metal.
 9. Window: Glass.
 10. Ring: Brass.
 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.04 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.05 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Terice, H. O. Co.
 3. Weiss Instruments, Inc.

- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

2.06 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Trerice, H. O. Co.
 - 3. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 160 deg F.
- D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- E. Carrying Case: Metal or plastic, with formed instrument padding.

2.07 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Emerson Process Management; Rosemount Division.
- C. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.
- D. Pentair Valves & Controls; Penberthy Brand.
- E. Description: Piping inline-installation device for visual verification of flow.
- F. Construction: Bronze or stainless-steel body, with sight glass and ball indicator, and threaded or flanged ends.
- G. Minimum Pressure Rating: 150 psig.
- H. Minimum Temperature Rating: 200 deg F.
- I. End Connections for NPS 2 and Smaller: Threaded.
- J. End Connections for NPS 2-1/2 and Larger: Flanged.

2.08 FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Onicon Meter, Inc.
 2. Neptune Technology Group Inc.
 3. Sensus Metering Systems.

- B. Meters capable of the following:
 1. Recording daily water consumption.
 2. Communicating data remotely. Pulse output.
 3. Water meter: Onicon model F-3500 series, single analog 4-20 mA output pulse, Painted Aluminum housing per NEMA6, Flow range of 0.5 -182,600 GPM, Carbon steel body material with Polypropylene liner material. Provide with D-100 modul

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 1. Inlet and outlet of each water heater.
 2. Inlets and outlets of each domestic water heat exchanger.
 3. Inlet and outlet of each domestic hot-water storage tank.
 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
 1. Building water service entrance into building.
 2. Inlet and outlet of each pressure-reducing valve.
 3. Suction and discharge of each domestic water pump.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
 - 1. Liquid-filled Sealed, bimetallic-actuated type.
 - 2. Direct-mounted, metal-case, vapor-actuated type.
 - 3. Compact-style, liquid-in-glass type.
 - 4. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:
 - 1. Liquid-filled Sealed, bimetallic-actuated type.
 - 2. Direct-mounted, metal-case, vapor-actuated type.
 - 3. Compact-style, liquid-in-glass type.
 - 4. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

3.06 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
 - 1. Liquid-filled Sealed Open-front, pressure-relief, direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
 - 1. Liquid-filled Sealed Open-front, pressure-relief, direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Liquid-filled Sealed Open-front, pressure-relief, direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 200 psi.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

**SECTION 22 0523
GENERAL DUTY VALVES FOR PLUMBING PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Ball valves.
 2. Butterfly valves.
 3. Check valves.
- B. Related Sections:
 1. Section 22 05 53 "Identification for Plumbing Piping and Equipment".
 2. Section 22 11 16 "Domestic Water Piping".
 3. Section 22 13 16 "Sanitary Waste and Vent Piping".
 4. Section 22 14 13 "Storm Drainage Piping".

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. PTFE: Polytetrafluoroethylene.

1.04 ACTION SUBMITTALS

- A. See Division 01 and Section 22 00 00 "Plumbing General Requirements" for submittal procedures.
- B. Product Data: For each type of valve.
 1. Certification that products that come into contact with potable water comply with NSF 61 Annex G and NSF 372.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: for each type of valve to include in operation and maintenance manuals.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, soldered ends, and grooves.
 3. Set ball valves open to minimize exposure of functional surfaces.
 4. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. Valves shall be manufactured in the United States.
- C. Coordinate joint connection with Valve schedule in Part 3 and piping system specifications.
- D. ASME Compliance:
 - 1. ASME B1.20.1 for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.9 for building service piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- F. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- G. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- H. Valve Actuator Types:
 - 1. Gear Actuator: For valves NPS 8 and larger.
 - 2. Handlever: For valves NPS 6 and smaller.
- I. Valves in Insulated Piping: With 2-inch stem extensions; operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
- J. All plumbing components including but not limited to valves and other wetted parts shall be lead free.

2.02 BALL VALVES

- A. Two-Piece, Bronze Ball Valves with Full Port:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - 2. Description: Two-Piece bronze body, chrome-plated brass ball, bronze trim, PTFE seat, steel handle with plated plastisol coating, 600 psig CWP rating.
 - 3. Standard: MSS SP-110.
- B. Steel Ball Valves with Full Port:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - 2. Description: Carbon steel (ASTM A216) split body, stainless steel ball and stem, PTFE seat.
 - 3. Standard: MSS SP-72.

2.03 BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Conbraco Industries, Inc.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. DeZURIK.
 - 2. Description: Cast iron (ASTM A126) or ductile iron (ASTM A536) lug type body, suitable for bidirectional dead-end service at rated pressure without use of downstream flange, EPDM seat, one or two piece stainless steel stem, nickel-plated ductile iron disc.
 - 3. Standard: MSS SP-67, Type I.
- B. Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. Tyco Fire Products LP.
 - 2. Description: Coated ductile iron body, EPDM seal, two-piece stainless-steel stem, coated ductile iron disc.
 - 3. Standard: MSS SP-67, Type I.

2.04 CHECK VALVES

- A. Bronze, Swing Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - 2. Description: Bronze (ASTM B62) body, spring loaded, bronze disc.
 - 3. Standard: MSS SP-80.
- B. Iron Swing Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. NIBCO INC.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - 2. Description: Gray iron (ASTM A126) body with bolted bonnet, clear or full waterway, spring-loaded, asbestos free gasket, bronze trim, bronze disc
 - 3. Standard: MSS SP-71, Type I.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

- C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves; replace with new valves.

3.02 INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 VALVE SCHEDULE

- A. Refer to piping system sections for valve schedules.
- B. Coordinate Class or CWP rating with associated piping system rating.
 - 1. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

END OF SECTION

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe positioning systems.
 - 7. Equipment supports.
- B. Related Sections:
 - 1. Division 05 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 3. Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.07 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. Flex-Strut Inc.
 - c. Unistrut; Part of Atkore International.
 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted steel channel with inturred lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 7. Paint Coating: Epoxy.

2.04 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carpenter & Paterson, Inc.
 2. National Pipe Hanger Corporation.
 3. Pipe Shields Inc.

- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.07 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.08 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Comply with requirements for pipe hanger and support devices and installation specified in section 313.0 of the California Plumbing Code.
- I. Comply with requirements of pipe hanger intervals for suspended piping per table 313.3 of the California Plumbing Code.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Open-spring isolators.
 - 2. Housed-spring isolators.
 - 3. Restrained-spring isolators.
 - 4. Housed-restrained-spring isolators.
 - 5. Pipe-riser resilient supports.
 - 6. Resilient pipe guides.
 - 7. Snubbers.
 - 8. Restraint channel bracings.
 - 9. Restraint cables.
 - 10. Seismic-restraint accessories.
 - 11. Mechanical anchor bolts.
- B. Related Requirements:
 - 1. Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
 - 2. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the CBC: B.
 - 2. Assigned Seismic Use Group or Building Category: III.
 - a. Component Importance Factor: 1.0
 - 3. Design Spectral Response acceleration at short periods (0.2 second): refer to drawing S/S-001
 - 4. Design Spectral Response acceleration at 1.0-second periods: refer to drawing S/S-001
 - 5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.02 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. California Dynamics Corporation.
 - b. Isolation Technology, Inc.
 - c. Mason Industries, Inc.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.03 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.04 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. California Dynamics Corporation.
 - b. Isolation Technology, Inc.
 - c. Mason Industries, Inc.
 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.05 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. California Dynamics Corporation.

- b. Kinetics Noise Control, Inc.
- c. Mason Industries, Inc.
- 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
- 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.06 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.07 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.08 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.09 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut; Part of Atkore International.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the

other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.10 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Gripple Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.11 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. TOLCO.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.12 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Specification section "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling.

Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Valve tags.
 5. Warning tags.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 1. Manufacturers:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers.
 - c. Seton Identification Products
 2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 3. Letter Color: Black.
 4. Background Color: White.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- 1. Manufacturers:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers.
 - c. Seton Identification Products
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Red.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

- 1. Manufacturers:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers.
 - c. Seton Identification Products
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.04 VALVE TAGS

- 1. Manufacturers:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers.
 - c. Seton Identification Products
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass beaded chain.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.05 WARNING TAGS

1. Manufacturers:
 - a. Brady Corporation
 - b. Craftmark Pipe Markers.
 - c. Seton Identification Products
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
- a. Provide pipe label color designation, background and lettering colors scheme per ANSI/ASME A13.1

3.05 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - c. Low-Pressure Compressed Air: Natural.
 3. Letter Colors:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Low-Pressure Compressed Air: White.

3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

**SECTION 22 0719
PLUMBING PIPING INSULATION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 01 81 13 "Sustainable Design Requirements" for additional Leadership in Energy and Environmental Design (LEED®) certification-related references, definitions, documentation requirements, action plans, meetings, and performance requirements of products and systems.

1.02 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic hot-water piping.
 - 2. Domestic recirculating hot-water piping.
 - 3. Roof drains and rainwater leaders.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation."

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Sustainable Design Submittals:
 - 1. A. LEED Submittal Requirements: Submit for Sustainability Consultant's review.
 - 2. A completed GREEN BUILDING MATERIAL CERTIFICATION FORM (GBMCF), as specified in Section 01 81 13 Information to be supplied for this form shall include:
 - 3. GBMCF Back-Up Documentation: These documents are used to validate the information provided on the GBMCF (except cost data). For each material listed on the GBMCF, provide documentation to certify the material's attributes, as applicable:
 - 4. Contractor is required to collect all LEED submittal documentation from the project's subcontractors and assemble into one (1) package per Section or trade, on the GBMCF provided, for review by the Sustainability Consultant. Submit GBMCF and Back-Up Documentation within 30 days of awarded contract. Incomplete or inaccurate LEED submittals may be used as the basis for rejecting the submitted products or assemblies.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ROXUL
 - b. Knauf Insulation.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Polyisocyanurate Foam insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Mansville.
 - b. Dow

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.04 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: Aluminum.

2.05 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.06 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. Underground Direct-Buried Jacket: **125-mil- (3.2-mm-)** thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Pittsburgh Corning
- C. Metal Jacket:
 - a. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - b. Certain-Teed.
 - c. Johns Mansville.
 - d. Owens Corning.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.08 SECUREMENTS

- A. Bands:
 - 1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.
- B. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

2.09 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. Insul-Tect Products Co.
 - c. Plumberex Specialty Products, Inc.
 - d. Truebro.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.

- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.08 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 UNDERGROUND PIPING INSULATION SCHEDULE

- A. Domestic Hot Water Supply, NPS 2" and less, expanded polyisocyanurate, thickness to match pipe size.

3.12 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/4" thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:

- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2" thick.
- B. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch <Insert dimension> thick.
 - b. Phenolic: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
- C. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
 - 2. Aluminum, Smooth: 0.016 inch thick.
- D. Piping, Exposed:
 - 1. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION

**SECTION 22 1116
DOMESTIC WATER PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.
- B. Related Requirements:
 - 1. Section 22 11 13 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.03 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G.

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.

- b. Elkhart Products Corporation.
- c. Viega LLC.
- 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.03 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51.
 - 2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- B. Standard-Pattern, Push-on-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Gaskets: AWWA C111/A21.11, rubber.
- C. Compact-Pattern, Push-on-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.
 - 2. Gaskets: AWWA C111/A21.11, rubber.
- D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.04 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.05 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: natural.

2.06 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.07 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. WATTS.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
 2. Standard: ASSE 1079.
 3. Factory-fabricated, bolted, companion-flange assembly.
 4. Pressure Rating: 125 psig minimum at 180 deg F.
 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 2. Nonconducting materials for field assembly of companion flanges.
 3. Pressure Rating: 150 psig.
 4. Gasket: Neoprene or phenolic.
 5. Bolt Sleeves: Phenolic or polyethylene.
 6. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Victaulic Company.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 150 psig at 160 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for

pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX piping with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."
- V. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.05 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flange kits.

3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.08 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.09 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
- 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be the following:
 - 1. Push-on-joint, ductile-iron pipe; standard- or compact-pattern, push-on-joint fittings; and gasketed joints.
- D. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast-copper, solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 3, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast-copper, solder-joint fittings; and brazed joints.

END OF SECTION

**SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Vacuum breakers.
 2. Backflow preventers.
 3. Water pressure-reducing valves.
 4. Balancing valves.
 5. Temperature-actuated, water mixing valves.
 6. Strainers.
 7. Hose bibbs.
 8. Wall hydrants.
 9. Drain valves.
 10. Water-hammer arresters.
 11. Trap-seal primer valves.
 12. Trap-seal primer systems.
 13. Flexible connectors.
- B. Related Requirements:
 1. Section 22 05 19 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 2. Section 22 32 00 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
 3. Section 22 45 00 "Emergency Plumbing Fixtures" for water tempering equipment.
 4. Section 22 47 13 "Drinking Fountains" for water filters for water coolers.
 5. Section 22 47 16 "Pressure Water Coolers" for water filters for water coolers.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

2.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: [Chrome or nickel plated] [Rough bronze].

2.04 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 10 psig maximum, through middle third of flow range.
 - 5. Size: .
 - 6. Design Flow Rate: .
 - 7. Selected Unit Flow Range Limits: .
 - 8. Pressure Loss at Design Flow Rate: for sizes NPS 2 and smaller; for NPS 2-1/2 and larger.
 - 9. Body: Bronze for NPS 2 and smaller; [cast iron with interior lining that complies with AWWA C550 or that is FDA approved] [steel with interior lining that complies with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 and larger.
 - 10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 11. Configuration: Designed for [horizontal, straight-through] [vertical-inlet, horizontal-center-section, and vertical-outlet] [vertical] <Insert configuration> flow.
 - 12. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Beverage-Dispensing-Equipment Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1022.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: NPS 1/4 or NPS 3/8.
 - 5. Body: Stainless steel.
 - 6. End Connections: Threaded.

- C. Dual-Check-Valve Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size
 - 5. Body: Bronze with union inlet.
- D. Hose-Connection Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Woodford Manufacturing Company.
 - 2. Standard: ASSE 1052.
 - 3. Operation: Up to 10-foot head of water back pressure.
 - 4. Inlet Size: NPS 1/2 or NPS 3/4.
 - 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
 - 6. Capacity: At least 3-gpm flow.
- E. Backflow-Preventer Test Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.05 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1003.
 - 3. Pressure Rating: Initial working pressure of 150 psig.
 - 4. Size: .
 - 5. Design Flow Rate: .
 - 6. Design Inlet Pressure: .
 - 7. Design Outlet Pressure Setting: .
 - 8. Body: Bronze[with chrome-plated finish] for NPS 2 and smaller; cast iron[with interior lining that complies with AWWA C550 or that is FDA approved] for NPS 2-1/2 and NPS 3.
 - 9. Valves for Booster Heater Water Supply: Include integral bypass.
 - 10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.06 BALANCING VALVES

- A. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Thermostatic self-actuating balancing valve:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ThermOmegaTech
- b. Approved Equal
- 2. Furnish and install Thermostatic self-actuating balancing valve as indicated on the plans. Self-actuating balancing valve shall be self-contained and fully automatic without additional piping or control mechanisms. Self-actuating balancing valve shall be a CircuitSolver® as manufactured by ThermOmegaTech®, Inc., or equivalent.
- 3. Self-actuating balancing valve shall regulate the flow of recirculated domestic hot water based on water temperature entering the valve regardless of system operating pressure.
 - a. As the water temperature increases the valve proportionally closes dynamically adjusting flow to meet the specified temperature.
 - b. The Self-actuating balancing valve never fully closes, even at the desired set point. There is always sufficient bypass flow back to the recirculating pump to prevent overheating or “dead heading” of the pump.
 - c. Self-actuating balancing valve shall be set at the factory for the desired return temperature, no field adjustments shall be required.
- 4. Self-actuating balancing valve body and all internal components shall be made with lead free materials with major components constructed of type 303 SS A.
- 5. Self-actuating balancing valve shall be rated to 200 PSIG maximum working pressure.
 - a. All self-actuating balancing valves shall be standard tapered female pipe thread, NPT.
 - b. All Self-actuating balancing valves shall be rated to 250° F maximum working temperature.
 - c. Thermal actuator shall be spring loaded and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.

2.07 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Bradley Corporation.
 - c. Leonard Valve Company.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Tempered-Water Setting: .
 - 9. Tempered-Water Design Flow Rate: .
 - 10. Valve Finish: Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Bradley Corporation.
 - c. Leonard Valve Company.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded/ union inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Tempered-Water Setting: .
9. Tempered-Water Design Flow Rate: .
10. Selected Valve Flow Rate at 45-psig Pressure Drop: .
11. Pressure Drop at Design Flow Rate: .
12. Valve Finish: [Chrome plated] [Polished, chrome plated] [Rough bronze].
13. Piping Finish: Copper.
14. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Bradley Corporation.
 - c. Leonard Valve Company.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: .
9. Tempered-Water Design Flow Rate: .

2.08 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron [with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and] for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: [Pipe plug] [Factory-installed, hose-end drain valve].

2.09 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: [Rough bronze] [Chrome or nickel plated].
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

- A. Moderate-Climate Wall Hydrants:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 3. Pressure Rating: 125 psig.
 - 4. Operation: Loose key.
 - 5. Inlet: NPS 3/4 or NPS 1.
 - 6. Outlet:
 - a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7.
 - 7. Box: Deep, flush mounted with cover.
 - 8. Box and Cover Finish: Chrome plated.
 - 9. Outlet:
 - a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7.
 - 10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
 - 11. Operating Keys(s): One with each wall hydrant.
- B. Vacuum Breaker Wall Hydrants:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1019, Type A or Type B.
 - 3. Type: automatic draining with integral air-inlet valve.
 - 4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
 - 5. Pressure Rating: 125 psig.
 - 6. Operation: [Loose key] [or] [wheel handle].
 - 7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 8. Inlet: NPS 1/2 or NPS 3/4.
 - 9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 2. Pressure Rating: 400-psig minimum CWP.
 - 3. Size: NPS 3/4.
 - 4. Body: Copper alloy.
 - 5. Ball: Chrome-plated brass.
 - 6. Seats and Seals: Replaceable.
 - 7. Handle: Vinyl-covered steel.
 - 8. Inlet: Threaded or solder joint.
 - 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

- B. Gate-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-80 for gate valves.
 2. Pressure Rating: Class 125.
 3. Size: NPS 3/4.
 4. Body: ASTM B 62 bronze.
 5. Inlet: NPS 3/4 threaded or solder joint.
 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- C. Stop-and-Waste Drain Valves:
 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
 2. Pressure Rating: 200-psig minimum CWP or Class 125.
 3. Size: NPS 3/4.
 4. Body: Copper alloy or ASTM B 62 bronze.
 5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Precision Plumbing Products.
 - c. Sioux Chief Manufacturing Company, Inc.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: [Metal bellows] [Copper tube with piston].
 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Precision Plumbing Products.
 - c. Sioux Chief Manufacturing Company, Inc.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Drainage-Type, Trap-Seal Primer Device:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Approved equal
 2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 3. Size: NPS 1-1/4 minimum.
 4. Material: Chrome-plated, cast brass.

2.14 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products.
 - b. Zurn Industries, LLC.

2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four.
8. Size Outlets: NPS 1/2.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flex Pression Ltd.
 2. Flex-Hose Co., Inc.
 3. Metraflex Company (The).
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with thermostatic self-actuating balancing valves. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install thermostatic self-actuating balancing valves in each domestic hot water return piping branch beyond last hot water device in that branch.
 1. Provide suitable line size isolation valves, unions, and strainer as indicated in piping detail shown on the drawings.
 2. Provide suitable access panel as required in non-accessible ceilings and walls.
 3. Pay close attention to flow arrow, especially with valves that have an integrated check valve.

- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve solenoid valve and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."
- H. Install water-hammer arresters in water piping according to PDI-WH 201.
- I. Install air vents at high points of water piping.[Install drain piping and discharge onto floor drain.]
- J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- K. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- L. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Dual-check-valve backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Thermostatic self-actuating balancing valves
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Manifold, thermostatic, water mixing-valve assemblies.
 - 7. Primary water tempering valves.
 - 8. Outlet boxes.
 - 9. Supply-type, trap-seal primer valves.
 - 10. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.03 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.04 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

**SECTION 22 1123
DOMESTIC WATER PUMPS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.
- B. Related Sections include the following:

1.03 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.08 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.01 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grundfos Pumps Corp.
 - 2. TACO Comfort Solutions, Inc.
 - 3. WILO USA LLC - WILO Canada Inc.

- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 2. Casing: Bronze, with threaded or companion-flange connections.
 3. Impeller: Plastic.
 4. Motor: Single speed, unless otherwise indicated.
- D. Capacities and Characteristics:
 1. See drawing schedule

2.02 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.03 CONTROLS

- A. Pressure Switches: Electric, adjustable for control of water-supply pump.
 1. Type: Water-immersion pressure sensor, for installation in piping.
 2. Enclosure: NEMA 250, Type 4.
 3. Operation of Pump: On or off.
 4. Transformer: Provide if required.
 5. Power Requirement: 120 V, ac.
 6. Settings: Start pump and stop pump per manufacturer requirement.
- B. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 1. Type: Water-immersion temperature sensor, for installation in piping.
 2. Range: 50 to 125 deg F.
 3. Enclosure: NEMA 250, Type 4.
 4. Operation of Pump: On or off.
 5. Transformer: Provide if required.
 6. Power Requirement: 120 V, ac.
 7. Settings: Start pump at 110 deg F and stop pump at 120 deg F.
- C. Timers: Electric, for control of hot-water circulation pump.
 1. Type: Programmable, seven-day clock with manual override on-off switch.
 2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
 3. Operation of Pump: On or off.
 4. Transformer: Provide if required.
 5. Power Requirement: 120-V ac.
 6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.
- D. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.
 1. Type: Adjustable time-delay relay.
 2. Range: Up to five minutes.
 3. Setting: Five minutes.
 4. Enclosure: NEMA 250, Type 4.
 5. Operation of Pump: On or off.
 6. Transformer: Provide if required.
 7. Power Requirement: 120-V ac.

8. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
 1. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
 2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- D. Install pressure switches in water supply piping.
- E. Install thermostats in hot-water return piping.
- F. Install timers.
- G. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.03 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping," and comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties."
 1. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- E. Connect pressure switches, thermostats, time-delay relays, and [timers] to pumps that they control.
- F. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.04 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 STARTUP SERVICE

- A. [Engage a factory-authorized service representative to perform] [Perform] startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.
 - 10. Adjust timer settings.

3.06 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

**SECTION 22 1316
SANITARY WASTE AND VENT PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Pipe, tube, and fittings.
 2. Specialty pipe fittings.
 3. Encasement for underground metal piping.
- B. Related Sections:
 1. Section 22 13 13 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
 2. Section 22 66 00 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.03 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities

occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AB&I
 - 2) Charlotte
 - 3) Tyler Pipe
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
 2. Standards: ASTM C 1277 and CISPI 310.
 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
 2. Standards: ASTM C 1277 and ASTM C 1540.
 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- E. Cast-Iron, Hubless-Piping Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. MG Piping Products Company.
 2. Standard: ASTM C 1277.
 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought

copper, solder-joint fittings.

- C. Hard Copper Tube: ASTM B 88, Type M, water tube, drawn temper.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.04 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell G-Fire by Johnson Controls Company.
 - c. Victaulic Company.
 - 2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 - 3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.05 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Fernco Inc.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - 3) Plastic Oddities.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

- B. Dielectric Fittings:
 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Josam Company.
 - 2) Matco-Norca.
 - 3) Precision Plumbing Products.
 - b. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 125 psig at 180 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.06 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions

for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: shall be installed level (no slope) or graded and connected as to drip back by gravity to the drainage pipe it serves, refer to section 905.1 of the California Plumbing Code.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings: Use dielectric nipples.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.07 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- B. Aboveground, vent piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

**SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Cleanouts.
 2. Floor drains.
 3. Roof flashing assemblies.
 4. Through-penetration firestop assemblies.
 5. Miscellaneous sanitary drainage piping specialties.
 6. Flashing materials.
- B. Related Requirements:
 1. Section 22 14 23 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that accessories, and components will withstand seismic forces defined in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 CLEANOUTS

- A. Exposed Metal Cleanouts <Insert drawing designation if any>:
 - 1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - 2. Standard: ASME A112.36.2M for cast iron <Insert standard> for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 - 5. Closure: cast-iron plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless-steel plug with seal.

2.02 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.3.
 - 3. Pattern: Floor drain.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Required.
 - 6. Anchor Flange: Required.
 - 7. Clamping Device: Required.
 - 8. Outlet: Bottom.
 - 9. Coating on Interior and Exposed Exterior Surfaces: Not required.
 - 10. Sediment Bucket: .
 - 11. Top or Strainer Material: Bronze.
 - 12. Top of Body and Strainer Finish: Nickel bronze.
 - 13. Top Shape: Square.
 - 14. Dimensions of Top or Strainer:
 - 15. Top Loading Classification: Heavy Duty.
 - 16. Trap Material: Cast iron.
 - 17. Trap Pattern: Standard P-trap.
 - 18. Trap Features: Trap-seal primer valve drain connection.

2.03 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ProVent Systems.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Hub Drains:
 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping.
- B. Floor-Drain, Trap-Seal Primer Fittings:
 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- C. Air-Gap Fittings:
 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- D. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend [1 inch] [2 inches] <Insert dimension> above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- E. Stack Flashing Fittings:
 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- F. Vent Caps:
 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- G. Expansion Joints:
 1. Standard: ASME A112.21.2M.
 2. Body: Cast iron with bronze sleeve, packing, and gland.
 3. End Connections: Matching connected piping.
 4. Size: Same as connected soil, waste, or vent piping.

2.06 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft..
 - 2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

- c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
- 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through-penetration firestop assemblies in plastic stacks at floor penetrations.
- I. Assemble hub drain fittings and install with top of hub 1 inch above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Install wood-blocking reinforcement for wall-mounting-type specialties.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.05 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

**SECTION 22 1319.13
SANITARY DRAINS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Floor drains.
 2. Floor sinks.
 3. Trench drains.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Refer to the Drawings for the basis of design products, characteristics, and required options.

2.02 FLOOR DRAINS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Zurn Industries, LLC.
 2. Jay R. Smith Mfg. Co.
 3. Josam Company.
- B. Body Material:
 1. Gray cast-iron. Floor drains shall be in accordance with ASME A112.6.3.
 2. Stainless steel. Floor drains shall be in accordance with ASME A112.3.1.
- C. Provide with no-hub, threaded, or inside gasket connection. Floor drains shall have internal seepage collar for embedding in floor construction and weep holes to provide adequate drainage to drain pipe. Provide clamping device where required or where indicated on drawings. Include trap primer connection where indicated on drawings.

2.03 FLOOR SINKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Zurn Industries, LLC.
 2. Jay R. Smith Mfg. Co.
 3. Josam Company.
- B. Body Material:
 1. Gray cast-iron. Floor sinks shall be in accordance with ASME A112.6.3.
 2. Stainless steel. Floor sinks shall be in accordance with ASME A112.3.1.
- C. Provide with no-hub, threaded, or inside gasket connection. Double drainage pattern floor sink shall have anchoring and seepage flanged for embedding in floor construction and weep holes

to provide adequate drainage to drain pipe. Provide clamping device where required or where indicated on drawings. Include trap primer connection where indicated on drawings.

2.04 TRENCH DRAINS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Zurn Industries, LLC.
 - 2. Jay R. Smith Mfg. Co.
 - 3. Josam Company.
- B. Body Material:
 - 1. Gray cast-iron. Trench drains shall be in accordance with ASME A112.6.3.
 - 2. Stainless steel. Trench drains shall be in accordance with ASME A112.3.1.
- C. Provide with no-hub, threaded, or inside gasket connection. Trench drain shall have anchoring and seepage flanged for embedding in floor construction and weep holes to provide adequate drainage to drain pipe. Provide clamping device where required or where indicated on drawings. Include trap primer connection where indicated on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 - 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
 - 1. Set grates of drains flush with finished surface, unless otherwise indicated.

3.02 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 22 13 23 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.
- E. Ground equipment according to Division 26.
- F. Connect wiring according to Division 26.

3.03 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.04 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

**SECTION 22 1323
SANITARY WASTE INTERCEPTORS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Grease interceptors.
- B. Related Requirements:
 - 1. Division 31 for earth moving.

1.03 DEFINITIONS

- A. PP: Polypropylene plastic.

1.04 ACTION SUBMITTALS

- A. Shop Drawings / Product Data: For each type and size of interceptor indicated.
 - 1. Include materials of construction; dimensions, including access opening; rated capacities; retention capacities; location, elevation, and size of each pipe connection; lid rating; lid removal process; furnished specialties; and accessories.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Piping connections. Include size, location, and elevation of each.
 - 2. Interface with underground structures and utility services.

PART 2 - PRODUCTS

2.01 GREASE INTERCEPTORS

- A. Precast Concrete Grease Interceptors:
 - 1. Comply with ASTM C913 and authorities having jurisdiction requirements.
 - 2. Structural Design Loads:
 - a. Heavy-Traffic Load: Comply with ASTM C890, A-16.
 - 3. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
 - a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR."

2.02 PRECAST CONCRETE MANHOLE RISERS

- A. Precast Concrete Manhole Risers: ASTM C478 ASTM C913, with rubber-gasket joints.
 - 1. Structural Design Loads:
 - a. Heavy-Traffic Load: Comply with ASTM C890, A-16.
 - 2. Length: From top of underground concrete structure to grade.
 - 3. Riser Sections: 3-inch minimum thickness and 36-inch diameter.
 - 4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.

5. Gaskets: ASTM C443, rubber.
 6. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
- B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.
- C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch-diameter cover.
1. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
 2. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
 3. Include indented top design with lettering cast into cover, using wording equivalent to the following: "SAND/OIL INTERCEPTOR".

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment Mounting:
1. Install grease interceptors and sand/oil interceptors on cast-in-place concrete equipment base(s).
 2. Comply with requirements for equipment bases and foundations specified in Division 03.
- B. Install precast concrete interceptors according to ASTM C891.
- C. Install interceptors according to manufacturer's requirements.
- D. Set interceptors level and plumb.
- E. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- F. Set tops of manhole frames and covers flush with finished surface in pavements.
1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.
- G. Set tops of grating frames and grates flush with finished surface.
- H. Set tops of interceptor covers flush with finished surface in pavements.
1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.
- I. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
1. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.
- C. Install per manufacturer's recommendations and AHJ requirements.

3.03 IDENTIFICATION

- A. Identification materials and installation are specified in Division 31.

1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 2. Use warning tapes or detectable warning tape over ferrous piping.
 3. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Grease interceptors.

3.04 PROTECTION

- A. Protect sanitary waste interceptors from damage during construction period.
- B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION

**SECTION 22 1413
STORM DRAINAGE PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Pipe, tube, and fittings.
 2. Specialty pipe fittings.
 3. Encasement for underground metal piping.
- B. Related Sections:
 1. Section 22 14 23 "Storm Drainage Piping Specialties" for area drains and roof drains connected to the storm and storm overflow drainage piping inside the building.

1.03 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. Storm and storm overflow drainage piping: 10-foot head of water.
- B. Seismic Performance: Storm and storm overflow drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: Storm and storm overflow drainage piping, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of storm drainage service.
 2. Do not proceed with interruption of storm drainage service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AB&I
 - 2. Charlotte
 - 3. Tyler Pipe
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- E. Cast-Iron, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. MG Piping Products Company.
 - 2. Standard: ASTM C 1277.
 - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

- D. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell G-Fire by Johnson Controls Company.
 - c. Victaulic Company.
 2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.04 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Fernco Inc.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - 3) Plastic Oddities.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) with pipe materials being joined.
 4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Josam Company.
 - 2) Matco-Norca.
 - 3) Precision Plumbing Products.
 - b. Description:
 - 1) Standard: IAPMO PS 66

- 2) Electroplated steel nipple.
- 3) Pressure Rating: 125 psig at 180 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.05 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Make changes in direction for storm and storm overflow drainage piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two area drains or roof drains are installed back to back or side by side with common drain pipe. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants,

cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- L. Install storm drainage and storm overflow drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Storm mains under the building: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal storm drainage and storm overflow drainage piping: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, non-pressure transition couplings.
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings: Use dielectric nipples.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect Storm and storm overflow drainage piping to exterior Storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to the following:
 - 1. Roof Drains and Roof Overflow Drains: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Storm Drainage Specialties: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 3. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.07 IDENTIFICATION

- A. Identify exposed storm and storm overflow drainage piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting roof drains and area drains.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm and storm overflow drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After storm drainage piping specialties have been set, test connections and prove they are gastight and watertight. Introduce air into piping system equal to pressure of 1-inch wg. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, storm and storm overflow drainage piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, storm and storm overflow drainage piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

**SECTION 22 1423
STORM DRAINAGE PIPING SPECIALTIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Roof drains.
 2. Miscellaneous storm drainage piping specialties.
 3. Cleanouts.
 4. Through-penetration firestop assemblies.
 5. Flashing materials.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Zurn Industries, LLC.
 2. Standard: ASME A112.6.4, for general-purpose roof drains.
 3. Body Material: Cast iron.
 4. Dimension of Body: Nominal 14-inch diameter.
 5. Combination Flashing Ring and Gravel Stop: Not required.
 6. Flow-Control Weirs: .
 7. Outlet: Bottom.
 8. Extension Collars: Required.
 9. Underdeck Clamp: Required.
 10. Expansion Joint: Not required.
 11. Sump Receiver Plate: Required.
 12. Dome Material: Cast iron.
 13. Perforated Gravel Guard: Not required.
 14. Vandal-Proof Dome: Required.
 15. Water Dam: 2 inches high.
- B. Metal, Medium-Sump, Promenade Roof Drains:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Zurn Industries, LLC.
 2. Standard: ASME A112.6.4, for promenade roof drains.

3. Body Material: Cast iron.
4. Dimension of Body: 11- to 12-inch diameter.
5. Dimension of Frame and Grate: Nominal 12 inches square.
6. Outlet: Bottom.
7. Grate Material: Cast iron.
8. Vandal-Proof Grate: Required.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Expansion Joint: Not required.
12. Sump Receiver Plate: Not required.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Downspout Adaptors:
 1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
 2. Size: Inlet size to match parapet drain outlet.
- B. Downspout Boots:
 1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
 2. Size: Inlet size to match downspout and NPS 4 outlet.
- C. Conductor Nozzles:
 1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
 2. Size: Same as connected conductor.

2.03 CLEANOUTS

- A. Floor Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
 3. Size: Same as connected branch.
 4. Type: .
 5. Body or Ferrule Material: Cast iron.
 6. Clamping Device: Required.
 7. Outlet Connection: Threaded.
 8. Closure: Brass plug with straight threads and gasket [Plastic plug].
 9. Adjustable Housing Material: Cast iron with set-screws or other device.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy Polished bronze.
 11. Frame and Cover Shape: Square.
 12. Top-Loading Classification: Heavy Duty.
 13. Riser: ASTM A 74, class, cast-iron drainage pipe fitting and riser to cleanout.
- B. Test Tees:
 1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
 2. Size: Same as connected drainage piping.
 3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
 4. Closure Plug: [Countersunk] [or] [raised head], [brass] <Insert material>.
 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- C. Wall Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jay R. Smith Mfg. Co.
- b. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ProVent Systems.
 2. Standard: ASTM E 814, for through-penetration firestop assemblies.
 3. Certification and Listing: for through-penetration firestop assemblies.
 4. Size: Same as connected pipe.
 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 7. Special Coating: Corrosion resistant on interior of fittings.

2.05 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Install expansion joints, if indicated, in roof drain outlets.
 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

- C. Install downspout boots at grade with top 6 inches above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- K. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 3300
ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Commercial, electric, storage, domestic-water heaters.
 2. Domestic-water heater accessories.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.04 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 1. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type commercial electric, domestic-water heater, from manufacturer.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.08 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: 1 year.
 - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.01 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradford White Corporation.
 - b. Lochinvar, LLC.
 - c. Smith, A. O. Corporation.
 - d. Refer to Schedules for Basis of Design.
 - 2. Standard: UL 1453.
 - 3. Storage-Tank Construction: ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.

- d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 5. Special Requirements: NSF 5 construction.
 - 6. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - 7. Special Requirements: NSF 5 construction with legs for off-floor installation.
- B. Capacity and Characteristics:
 - 1. Capacity:
 - a. Refer to Schedules.
 - 2. Electrical Characteristics:
 - a. Refer to Schedules.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. O. Smith Corporation.
 - b. AMTROL, Inc.
 - c. Watts.
 - 2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
 - 3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 4. Capacity and Characteristics:
 - a. Air Precharge Pressure: Factory pre-charged.
 - b. Refer to Schedules.

- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: Water heater manufacturer factory supplied.
- E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple tankless domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
 - 1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 0523 General duty valves for Plumbing Piping
 - 2. Comply with requirements for balancing valves specified in Section 22 1119 "Domestic Water Piping Specialties."
- F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.
- M. Condensate neutralization kit for condensing water heaters.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 3000 "Cast-in-Place Concrete." or Section 03 3053 "Miscellaneous Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
 1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 0523 General duty Valves for Plumbing Piping."
- D. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap to exterior or onto closest indirect receptor with 1 inch airgap above flood rim.
- F. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap to exterior or onto closest indirect receptor with 1 inch flood rim.
- G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains with 1 inch airgap above flood rim . Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 1119 "Domestic Water Piping Specialties."
- H. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 0519 "Meters and Gages for Plumbing Piping."
- I. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 0523 General Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 22 0519 "Meters and Gages for Plumbing Piping."
- J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- K. Fill electric, domestic-water heaters with water.
- L. Charge domestic-water expansion tanks with air, as required.
- M. Provide code required vacuum relief valves when water heaters are installed above floodrim of fixtures served.

3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 1116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 4000 "Quality Requirements" for retesting and reinspecting requirements and Section 01 7300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

END OF SECTION

**SECTION 22 4200
PLUMBING FIXTURES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Urinals.
 - 3. Lavatories.
 - 4. Sinks.
 - 5. Drinking Fountains.
- B. Related Requirements:
 - 1. Section 22 11 16 "Domestic Water Piping".
 - 2. Section 22 13 16 "Sanitary Waste and Vent Piping".

1.03 DEFINITIONS

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, clearances, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.
 - 2. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed, but no fewer than one of each type.
 - 3. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Materials:
 - 1. Vitreous china fixtures shall be of highest quality, non-absorbent, hard-burned, and vitrified throughout.
 - 2. Enameled ware shall be quality cast iron of uniform thickness and density, glazed to uniform depth and high gloss rubbed smooth, without chips or flaws, craze, or cracks, and completely acid resisting.
 - 3. Stainless steel fixtures shall be 302/304 types of non-corrosive steel, 18 gage (1.20 mm) self rim for cabinet sinks, 14 gage for free standing compartment type sinks. Sink material shall have satin finish and cover corners, with faucet holes punched to match specified faucet fitting.
 - 4. Insulation for traps and supplies shall be molded closed cell vinyl insulation and shall meet ASTM E84 for flame and smoke spread. Insulation shall be vandal resistant.
- B. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components – Health Effects," for supply-fitting materials that will be in contact with potable water.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 WATER CLOSETS

- A. All water closet and flushometer combinations shall have a Maximum Performance Test (MaP) score of 800 or greater when the flushometer is tested with the water closet.
- B. Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.
- C. Wall Hung or Floor Mounted:
 - 1. Fixture: white vitreous china, siphon jet, elongated bowl, 1.1 gal per flush, NPS 1-1/2 top inlet spud.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Zurn Industries, LLC
 - 2) American Standard America.
 - 3) Kohler Co.
 - b. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - 2. Flushometer Valve: chrome plated exposed manual diaphragm flushometer, brass body with corrosion resistant components, integral check stop and backflow preventer, 125 psig minimum pressure rating.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Sloan Valve Company.
 - 2) American Standard
 - 3) Zurn Industries, LLC.
 - b. Standard: ASSE 1037.
 - 3. Seat: Commercial, elongated rim, open front, white plastic, self-sustaining hinge of noncorroding metal.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Bemis Manufacturing Company.
 - 2) Church Seats; Bemis Manufacturing Company.
 - 3) Olsonite Seat Co.
 - b. Standard: IAPMO/ANSI Z124.5.
 - 4. Water Closet Carrier: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching

fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

- a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Zurn Industries, LLC.
 - 2) J.R. Smith
 - 3) Mifab
- b. Standard: ASME A112.6.1M.

2.03 URINALS

- A. Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.
- B. Wall Hung:
 - 1. Fixture: white vitreous china, washout type with extended shields, integral trap, 0.125 gpm per flush, NPS 3/4 top inlet spud, NPS 2 back outlet.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Standard America.
 - 2) Kohler Co.
 - 3) Zurn Industries, LLC.
 - 4) Sloan
 - b. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - 2. Flushometer Valve: chrome plated exposed manual diaphragm flushometer, water sense listed, brass body with corrosion resistant components, integral check stop and backflow preventer, 125 psig (860 kPa) minimum pressure rating.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Sloan Valve Company.
 - 2) American Standard
 - 3) Zurn Industries, LLC.
 - b. Standard: ASSE 1037.
 - 3. Type I Urinal Carrier:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Jay R. Smith Mfg. Co.
 - 2) Watts; a Watts Water Technologies company.
 - 3) Zurn Industries, LLC.
 - 4) Mifab
 - b. Standard: ASME A112.6.1M.

2.04 LAVATORIES

- A. Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.
- B. Lavatory: Rectangular, vitreous china, under mounted.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Kohler Co.
 - 2) Zurn Industries, LLC.
 - 3) Sloan
 - b. Fixture:
 - a) Standard: ASME A112.19.2/CSA B45.1.
 - b) Type: Undercounter mounting.
 - c) Nominal Size: Rectangular, 14-5/16 by 19-1/2 inches.
 - d) Faucet-Hole Location: on counter.
 - e) Color: White <Insert color>.
 - f) Mounting Material: Sealant.

- c. Faucet: automatic type, battery powered, electronic sensor operated, mixing, solid brass valve, rigid spout with aerator. Maximum flow rate: 0.35 gpm (1.5 L/min). Metering faucets shall remain open for 10 seconds minimum per CBC 11B-606.4. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a) Chicago Faucets; Geberit Company.
 - b) Sloan Valve Company.
 - c) Speakman Company.
 - 2) Standards: ASME A112.18.1/CSA B125.1 and UL 1951.

C. Wall Mounted:

- 1. Fixture: white vitreous china, Rectangle 20-1/2" x 18-1/4", one hole top faucet punching.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Standard America.
 - 2) Kohler Co.
 - 3) Zurn Industries, LLC.
 - 4) Sloan
 - b. Standard: ASME A112.19.2/CSA B45.1.
- 2. Faucet: automatic type, battery powered, electronic sensor operated, mixing, solid brass valve, rigid spout with aerator. Maximum flow rate: 0.35 gpm (1.5 L/min). Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Chicago Faucets; Geberit Company.
 - 2) Sloan Valve Company.
 - 3) Speakman Company.
 - b. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
- 3. Type II Lavatory Carrier:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Jay R. Smith Mfg. Co.
 - 2) Watts; a Watts Water Technologies company.
 - 3) Zurn Industries, LLC.
 - 4) Mifab
 - b. Standard: ASME A112.6.1M.
- 4. Supply Fittings: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange, chrome-plated-brass supply stops, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
 - a. Standard: ASME A112.18.1/CSA B125.1.
- 5. Waste Fittings: grid type with NPS 1-1/4 offset and straight tailpiece, chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thickthick brass tube to wall; and chrome-plated, brass or steel wall flange.
 - a. Standard: ASME A112.18.2/CSA B125.2.

2.05 SINKS

- A. Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.
- B. UTILITY SINKS
 - 1. Utility Sinks: Stainless steel, counter mounted.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Elkay
- b. Just Manufacturing
- 3. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Ledge back.
 - c. Number of Compartments: One Two.
 - d. Overall Dimensions: See Architectural drawing
 - e. Metal Thickness: 0.050 inch.
 - f. Compartment:
 - 1) Dimensions: See Architectural drawing .
 - 2) Drain: Grid with NPS 2 tailpiece and twist drain.
 - 3) Drain Location: Centered in compartment/ Near back of compartment.
 - 4) Garbage disposal: In non-ADA compartment
 - g. Faucet(s):
 - 1) Number Required: One, Manual- Hot & cold mixer.
 - 2) Mounting: On ledge.
 - 3) Flow: 1.0 gpm, with water sense label
 - h. Supply Fittings:
 - 1) Standard: ASME A112.18.1/CSA B125.1.
 - a) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - b) Operation: Loose key.
 - c) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.
 - i. Waste Fittings:
 - 1) Standard: ASME A112.18.2/CSA B125.2.
 - 2) Trap(s):
 - a) Clay Trap, if required per schedule
 - b) Size: NPS 2.
 - c) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.
 - d) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
 - 3) Continuous Waste:
 - a) Size: NPS 2.
 - b) Material: Chrome-plated, 0.032-inch- thick brass tube.
 - j. Mounting: On counter with sealant.
 - k. Garbage disposal
- C. Service Basin, floor mounted:
 - 1. Fixture: white terrazzo, square 24" x 24", height of 10 inches, rim guard on front top surface, grid type drain with NPS 3 outlet, mounted flush to wall.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Florestone Products Co., Inc.
 - 2) Stern-Williams Co., Inc.
 - 3) Acorn Engineering Company.
 - 4) Just Manufacturing
 - b. Standard: IAPMO PS 99.
 - 2. Faucet: manual type, two-lever handle, cross four arm; rigid solid brass spout with wall brace. Maximum flow rate: 2.2 gpm . Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor. Include hose thread spout and vacuum breaker.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Bradley Corporation.
 - 2) Speakman Company.
 - 3) T & S Brass and Bronze Works, Inc.
 - 4) Chicago Faucets
- b. Standard: ASME A112.18.1/CSA B125.1.
- 3. Type II Sink Carrier:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Jay R. Smith Mfg. Co.
 - 2) Watts; a Watts Water Technologies company.
 - 3) Zurn Industries, LLC.
 - b. Standard: ASME A112.6.1M.
- 4. Supply Fittings: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange, chrome-plated-brass supply stops, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
 - a. Standard: ASME A112.18.1/CSA B125.1.
- 5. Waste Fittings: grid type with NPS 1-1/2 offset and straight tailpiece, chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
 - a. Standard: ASME A112.18.2/CSA B125.2.
- 6. Grout: hydraulic cement, nonshrink, premixed, post-hardening and volume-adjusting, dry 5000 psi 28 day compressive strength
 - a. Standard: ASTM C1107/C1107M, Grade B.

2.06 DRINKING FOUNTAINS

- A. Wall-mounted:
 - 1. Fixture: stainless steel rectangular receptor with wall plate behind fountain, two bubblers with adjustable stream regulator, 0.5 gpm, push button control, Refrigerated, bottle filler, grid type drain with NPS 1-1/4 outlet, chrome-plated brass P-trap and waste fitting, NPS 3/8 supply with shutoff valve.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkay Manufacturing Co.
 - 2) Oasis International.
 - 3) Stern-Williams Co., Inc.
 - b. Standard: ASME A112.19.3/CSA B45.4.
 - 2. Type I Water Cooler Carrier:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Jay R. Smith Mfg. Co.
 - 2) Josam.
 - 3) Watts; a Watts Water Technologies company.
 - b. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Install level and plumb according to roughing-in drawings.
 - 2. Install accessible fixtures at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
 - 3. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
 - 4. Install according to manufacturer's instructions.

- B. Water-Closet Installation:
 - 1. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
 - 2. Support Installation:
 - a. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
 - b. Use carrier supports with waste-fitting assembly and seal.
 - c. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
 - 3. Flushometer-Valve Installation:
 - a. Install flushometer-valve, water-supply fitting on each supply to each water closet.
 - b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - c. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
 - d. Install actuators in locations that are easy for people with disabilities to reach.
 - 4. Install toilet seats on water closets.

- C. Urinal Installation:
 - 1. Support Installation:
 - a. Install supports, affixed to building substrate, for wall-hung urinals.
 - b. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
 - c. Use carriers without waste fitting for urinals with tubular waste piping.
 - d. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
 - 2. Flushometer-Valve Installation:
 - a. Install flushometer-valve water-supply fitting on each supply to each urinal.
 - b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - c. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

- D. Lavatory Installation:
 - 1. Install supports, affixed to building substrate, for wall-mounted lavatories.
 - 2. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

- E. Sink Installation:
 - 1. Install sinks level and plumb according to roughing-in drawings.
 - 2. Install supports, affixed to building substrate, for wall-hung sinks.
 - 3. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
 - 4. Set floor-mounted sinks in leveling bed of cement grout.
 - 5. Install water-supply piping with stop on each supply to each sink faucet.
 - 6. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
 - 7. Install stops in locations where they can be easily reached for operation.
 - 8. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

9. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
 10. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
 11. Install supports, affixed to building substrate, for wall-hung sinks.
 12. Set floor-mounted sinks in leveling bed of cement grout.
 13. Install water-supply piping with stop on each supply to each sink faucet.
 - a. Exception: Use ball valves if supply stops are not specified. Comply with valve requirements specified in Section 22 05 23 "General Duty Valves for Plumbing Piping".
 - b. Install stops in locations where they can be easily reached for operation.
- F. Drinking Fountain Installation:
1. Install recessed drinking fountains secured to blocking in wall construction.
 2. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
 3. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23 "General Duty Valves for Plumbing Piping".
 4. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
 3. Comply with escutcheon requirements specified in Division 22.
- H. Joint Sealing:
1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
 2. Match sealant color to water-closet color.
 3. Comply with sealant requirements specified in Division 07.

3.03 CONNECTIONS

- A. Connect fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.04 ADJUSTING

- A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION

- A. Clean fixtures and fittings with manufacturers' recommended cleaning methods and materials.

- B. After installation and prior to occupancy, install protective covering for installed fixtures and fittings. Remove protection once Certificate of Occupancy is obtained.
- C. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 0000
HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 01.
- B. The requirements of the General Conditions and Supplementary Conditions.

1.02 SUMMARY

- A. Furnish and install a complete (fully tested, adjusted, and ready for operation) mechanical system and fully automatic indoor space thermal conditioning and ventilation (commonly "HVAC") system with associated controls as described by the Contract Drawings and Specifications.
- B. The HVAC systems and design described in the Project documents reflect a building designed for low consumption of energy and water and minimum environmental footprint. Any modifications to the systems described herein shall maintain or improve on the sustainability and energy efficiency features of the project.
- C. All design modifications that pertain to system selection, system energy efficiency and energy use, material selection and indoor air quality issues shall require the approval of Integral Group.
- D. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
- E. Check, verify, and coordinate Work with Contract Drawings and Specifications prepared by all other trades. Include modifications, relocations, and adjustments necessary to complete work or avoid interference with other trades.
- F. Where architectural features govern location of Work, refer to Architectural Drawings.
- G. Contractor may install additional piping, fittings, and valves, not shown on the drawings, for testing purposes or convenience of installation. Where such materials are installed, they shall comply with the specifications and shall be properly sized for the system and operation. Remove such installed materials when they interfere with design conditions or as directed by the Architect.
- H. LEED: This building shall be LEED certified. Contractor and their subs shall provide all relevant support documentation pertaining to the LEED credits that relate to their work.
- I. The total noise level resulting from the simultaneous operation of all mechanical equipment after balancing (including ventilation fan noise, regenerated noise, breakout noise, and structure-borne noise) at their design duties shall not exceed the noise criteria limits as specified in the schedule on the design drawings.
- J. Commissioning: The scope of work for the Contractor shall not include the duties of the Commissioning Authority (CxA). Contractor will be required, however, to include in their scope of work duties relevant to the commissioning process, including but not limited to training of owner's personnel in the operation of the HVAC equipment, providing manufacturer's startup and pre functional checklists and contractor-provided pre-functional and startup checklists to Commissioning Authority, performing and documenting pre-functional tests for HVAC equipment, performing and documenting functional tests for HVAC equipment, supporting DDC Contractor and Test and Balance Contractor in the performance of their duties, and providing operations and maintenance manuals.

1.03 CODES AND STANDARDS

- A. All work and materials shall be in full accordance with the latest local rules and regulations, applicable sections of the California Code of Regulations, Title 24, State Fire Marshal, the Safety Orders of the Division of Industrial Safety, the California Electric Code and applicable State requirements. Nothing in these Plans and Specifications is to be construed to permit work not conforming to these requirements.
- B. HVAC system installers shall be trained and certified in the proper installation of HVAC systems including ductwork, pipework, and equipment by a nationally or regionally recognized training or certification program. Uncertified persons may perform HVAC installations when under the direct supervision and responsibility of a person trained and certified to install HVAC systems or a contractor licensed to install HVAC systems.
- C. Wherever the Specifications call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these Specifications shall govern. Should there be any direct conflict between the above rules and regulations and the Specifications the rules shall govern.
- D. Equipment shall have UL label listing.

1.04 DESIGN CONDITIONS

- A. Ambient Temperature for condensing equipment: 95 deg F.
- B. Project is adjacent to salt body of water and will require corrosion protection. Refer to equipment specifications.

1.05 DRAWINGS

- A. Layout of the equipment and work is diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. Any interference noted between different drawings, and between drawings and actual field conditions shall be brought to the attention of the Architect and Engineer of Record for a decision. The right is reserved to make any reasonable change in location of equipment without additional expense to the Owner.
- B. For purposes of clarity and legibility, drawings are diagrammatic to the extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping and ductwork and locations of equipment shall be governed by structural conditions and obstructions. Contractor shall make use of all data in Contract Drawings and Specifications and field conditions.
- C. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, shop drawings of the proposed rearrangement. Because of the diagrammatic nature and small scale of the Contract Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the structural and finish conditions affecting all the Work and shall arrange such Work accordingly, furnishing such fittings, equipment, accessories, etc., as may be required to meet such conditions, at no increase in Contract Sum.
- D. The construction documents for this project were prepared by the design team using 3d Revit™ Modeling software. Using this software by the design team does not relieve the Contractor from performing the necessary coordination to provide complete, code compliant and operational building systems. The plans and sections provided are diagrammatic and show the design intent, these are not intended to be used for fabrication or installation. Contractor is responsible for generating shop drawings for fabrication that meet the design intent as shown on the Contract Documents. The exact location of the piping, ductwork, electrical and support components are to be determined by the Contractor. All building sections and details provided are for information only and do not relieve the Contractor from performing final coordination. Contractor is responsible for coordinating with all other trades.

- E. All dimensions and locations of equipment, doors, partitions, etc., are to be taken from the architectural plans but shall be verified at the site.
- F. Coordination with Structural Work: The Contractor shall be responsible for being aware of the nature and arrangement of the materials and construction to which the work attaches or passes through, and shall propose support and penetration details that are consistent with maintaining the integrity and performance of the construction such as, but not limited to, fire-resistive construction, acoustically rated construction, vibrated isolated construction, water tight construction, fire proofed construction, and isolated construction.

1.06 COORDINATION WITH OTHER WORK

- A. Contractor performing Work under this Section shall become thoroughly familiar with the Drawings and Specifications. Contractor shall adjust the Work to conform with the conditions shown on these drawings to provide the best possible assembly of the combined Work.
- B. Obtain necessary information from the other trades regarding location of their work in order that the Work in this Section may be placed in correct position.
- C. The inclusion and proper location of supports, pads, sleepers, openings, anchorages, etc. provided by others is the responsibility of the Contractor under this Section. Cutting and/or boring shall be permitted under this Section only with the written approval of the Architect.
- D. It shall be the Contractor's responsibility to coordinate and have provided by other trades where not covered by the Contractor's scope of work, all electrical wiring and power to equipment, controls and devices, and any other work from other trades as required to provide fully functioning HVAC systems per the Contract Drawings and Specifications.
- E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no cost impact to the owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.07 MANUFACTURER'S DIRECTIONS

- A. Manufacturer's directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Contract Drawings and Specifications.

1.08 PROTECTION OF WORK

- A. Equipment and materials shall be stored on dunnage and remain wrapped at all times until installed.
- B. Duct and piping shall be remain capped during delivery and storage.
- C. During installation, all installed duct and piping shall be capped and protected at the open ends at the end of each working day.
- D. Equipment shall be protected from weather and stored in an enclosed, indoor location.
- E. Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

1.09 WORKMANSHIP

- A. Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Architect or Engineer of Record, be removed

and replaced in a satisfactory manner, without change in Contract Sum or additional cost to the Owner.

1.10 CLOSING IN UNINSPECTED WORK

- A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect, Engineer of Record, and/or Commissioning Authority.
- B. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the Owner.

1.11 EQUIPMENT ANCHORING

- A. Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes without compromising the performance of acoustic or vibration isolation mounting.

1.12 PRELIMINARY OPERATION

- A. Under this section, Contractor shall supervise and direct preliminary operation of systems should the Owner demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses for such preliminary operation will be paid by the Owner. Such preliminary operation or payment shall not be construed as an acceptance of the work.

1.13 FINAL INSPECTION

- A. At the time of final inspection, a service representative shall be available to make final adjustments.

1.14 FINAL OPERATION

- A. After acceptance of the installation, instruct the Owner's Representative in operation and maintenance, for a period of three (3), non-consecutive working days at a time requested by the Owner during the first year of warranty.
- B. At the beginning of the instruction period, deliver to the Owner three (3) copies of a durable binder as described under "Operating Instructions".

1.15 OPERATING INSTRUCTIONS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these Specifications.
- B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the General Contractor for inclusion in the O&M manuals prior to the training of Owner personnel.
- C. In addition, DDC Contractor shall provide O&M material as required by "Completion Requirements" in Part 1 of Section 23 09 23.
- D. Provide a summary of operating sequences (start-up, normal run, and shut-down, and control shop drawings in the main mechanical room.
- E. Provide electronic PDF copies. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists.
- F. Provide a pdf copy of the O&M manuals to the Commissioning Authority for review.

1.16 TRAINING OF OWNER PERSONNEL

- A. The General Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. The Commissioning Authority (CxA) shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
- C. The Mechanical Contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan two weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, air conditioning units, air handling units, fans, boilers, terminal units, controls, water treatment systems, etc.
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 - 6. The DDC Contractor shall attend sessions other than the DDC System training, as requested, to discuss the interaction of the DDC System as it relates to the equipment being discussed.
 - 7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 8. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. Instruction in the use of equipment controls that are integral to equipment or are provided by the equipment manufacturer, such as VRF System controls. This is in addition to and separate from DDC System training (see below) and does not replace or satisfy the requirement for such training, if specified. Equipment controls training shall include at least the following:

- 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system and any interface with security and communication systems.
- 2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
- 3) If system supports trending, all trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
- 4) Every screen shall be completely discussed, allowing time for questions.
- 5) Use of keypad or plug-in laptop computer for mobile control access.
- 6) Use of remote access to the system via phone lines or networks, if applicable.
- 7) Graphics generation, if applicable.
- 8) Point database entry and modifications, if applicable
 - i. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.
 - j. Classroom sessions may include the use of overhead projections, computer PowerPoint presentation, slides, video/audio-taped material as might be appropriate. A video record of the training session is suggested but not required.
9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
10. The Mechanical Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
11. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

D. DDC Contractor.

1. See TRAINING in Part 3 of Section 25 50 00 for DDC System training requirements and DDC Contractor obligations.
2. DDC Contractor shall coordinate with Mechanical Contractor and Commissioning Authority regarding training on equipment-integrated or manufacturer-supplied control systems as described above. Such training is the responsibility of Mechanical Contractor but may be adopted by DDC Contractor by mutual agreement, to facilitate a more integrated training experience.

E. DDC Contractor.

1. Not applicable due to no DDC Building Automation System.
2. Mechanical Contractor is responsible for training on equipment-integrated or manufacturer-supplied control systems as described above.

F. Test and Balance (TAB) Contractor. The TAB Contractor shall have the following training responsibilities:

1. TAB Contractor shall meet with facility staff after completion of TAB and instruct them on the following:
 - a. Go over the final TAB report, explaining the layout and meanings of each data type.
 - b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

- c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
- d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
- e. Other salient information that may be useful for facility operations, relative to TAB.

1.17 WARRANTY

- A. In accordance with Division 01 Project Closeout requirements, Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.
- B. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship, or finish.
- C. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a minimum period of one (1) year from date of Certificate of Occupancy, or per Division 01, whichever is longer.
- D. Warranty also services including instructions, adjusting, testing, noise, balancing, etc.
- E. For each piece of equipment or device with a manufacturer's warranty in excess of one year, Contractor shall furnish certificate of manufacturer's warranty and contact information for manufacturer's warranty service. Contractor shall also provide a list or table of all equipment with warranties exceeding one (1) year in duration.
- F. Provide new materials, equipment, apparatus, labor and/or service, and support to correct or replace that determined by the Owner to be defective or faulty.
- G. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.
- H. For DDC System, see WARRANTY and WARRANTY MAINTENANCE in Part 1 of Section 25 50 00. DDC System warranty commences upon the acceptance of COMPLETION REQUIREMENTS described in Part 1 of that Section, which may occur after the Certificate of Occupancy.
- I. After a period of 90 calendar days from date of acceptance of systems by Owner, provide, at no cost to the Owner, one service mechanic for an 8-hour period over as many working days as required to repair, replace any latent deficiency.

1.18 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.01 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

2.02 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an Inside Diameter to closely fit around pipe, tube, and insulation of insulated piping and an Outside Diameter that completely covers opening. Polished chrome-plated finish.
 - 1. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass.
 - 2. One-Piece, Cast-Brass Type: With set screw.
 - 3. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

PART 3 - EXECUTION

3.01 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.02 CUTTING AND OPENINGS

- A. Comply with Division 01 "Cutting and Patching".

3.03 EQUIPMENT INSTALLATION

- A. Install equipment to minimize pressure drop and allow adequate access headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated in drawings (note that in some cases non-parallel installation is indicated in the drawing to reduce pressure drop).
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.04 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions required to prevent bolt "pull out", and not less than 4 inches (10 cm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (46 cm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 145 PCF, 56-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Related Sections include the following:
 1. Section 26 29 22 "Variable-Frequency Motor Controllers".
 2. Section 23 21 23 "Hydronic Pumps".
 3. Section 23 34 00 "HVAC Fans".

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.
- B. Install vibration isolation for all motor driven equipment.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Duty: Continuous duty at ambient temperature of 104 °F (40 C) and at altitude of 3300 feet (1000 m) above sea level.
- C. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- D. Motors for submersible pumps shall be hermetically sealed.
- E. Motors 1 HP (560 W) or greater shall be polyphase unless otherwise indicated.
- F. Minimum Motor Service Factor: 1.15.

2.02 MOTOR ENCLOSURES

- A. Totally Enclosed, Fan Cooled (TEFC) for motors located outdoors, or in unconditioned or unventilated indoors areas, or in air streams unless otherwise indicated.
- B. Open Drip-proof (ODP) for other cases unless otherwise indicated.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency, as defined in NEMA MG 1.
- C. Polyphase motors shall be suitable for use with Variable-frequency Drives.
- D. Construction:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes to 1600 volts, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 3. Provide motor shaft grounding ring.
 - 4. Rotor: Random-wound, squirrel cage.
 - 5. Bearings: Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- E. Multispeed Motors: Separate winding for each speed.
- F. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.04 SINGLE-PHASE MOTORS

- A. Single-phase motors larger than 1/20 HP (37.5 W) shall be Electronically Commutated (ECM) unless not offered by the manufacturer.
- B. Electronically Commutated Motors (ECM)
 - 1. Motor shall be brushless DC type specifically designed for HVAC applications with heavy duty ball bearings and Electronic Commutation. It shall contain internal circuitry that converts single phase power into a DC signal. Speed control is achieved through a 0-10 volt DC control signal input through the pre-wired controls wires.
 - 2. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.
- C. Non-ECM
 - 1. Motors shall be one of the following, to suit starting torque and requirements of specific motor application (listed in order of preference):
 - a. Permanent-split capacitor.
 - b. Capacitor start, capacitor run.
 - c. Capacitor start, inductor run.
 - d. Split phase.
 - 2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 - 3. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 - 4. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Motors 1/20 HP (37.5 W) and Smaller: Shaded-pole type.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 23 0517**SLEEVES AND SLEEVE SEALS FOR HVAC PIPING****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Sleeves.
 2. Sleeve-seal systems.
 3. Grout.
- B. Related Requirements:
 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS**2.01 SLEEVES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. GPT; an EnPro Industries company.
- B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. GPT; an EnPro Industries company.
 4. Metraflex Company (The).
- B. Description:
 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 2. Designed to form a hydrostatic seal of 20-psig.
 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 4. Pressure Plates: Carbon steel.

5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.03 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 3 inches above finished floor level.
 3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for fire-stopping and fill materials specified in Section 078413 "Penetration Fire-stopping."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs-on-Grade: Piping Smaller Than 6-inches: Steel pipe sleeves with sleeve-seal system.
 - a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Interior Partitions: Galvanized-steel sheet sleeves.

3.05 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

**SECTION 23 0523
VALVES FOR HVAC PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Ball valves.
 2. Butterfly valves.
 3. Check valves.
- B. Related Sections:
 1. Section 23 05 53 "Identification for HVAC Piping and Equipment".
 2. Section 23 21 13 "Hydronic Piping".

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. PTFE: Polytetrafluoroethylene.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: for each type of valve to include in operation and maintenance manuals.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set ball valves open to minimize exposure of functional surfaces.
 4. Set butterfly valves closed or slightly open.
 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

- B. Valves shall be manufactured in the United States.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Apollo Flow Controls; Conbraco Industries, Inc.
 - 2. Crane; Crane Energy Flow Solutions.
 - 3. Milwaukee Valve Company.
 - 4. Mueller Co.
 - 5. NIBCO INC.
 - 6. Or equal
- D. Manufacturers for grooved end valves: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grinnell Mechanical Products.
 - 2. Victaulic Company.
 - 3. Or equal.
- E. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B31.1 for power piping valves.
 - 6. ASME B31.9 for building services piping valves.
- F. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- G. Valve Bypass and Drain Connections: MSS SP-45.
- H. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted. See ASTM B 584.
- I. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures. See Table in Part 3.
- J. Valve Sizes: Same as upstream piping unless otherwise indicated.
- K. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
 - 2. Handlever: For quarter-turn valves smaller than NPS 4 (DN 100).
 - 3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Valve Installation" Article.
- L. Valves in Insulated Piping:
 - 1. Include stem extensions to extend stem out of insulation, 2-inches (50-mm) minimum.
 - 2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.
- M. All hydronic components including but not limited to valves and other wetted parts shall be lead free.

2.02 BALL VALVES

- A. Two-Piece Bronze Ball Valves with Full Port:
 - 1. Description: Two-Piece bronze body; stainless steel ball, vented; stainless steel stem; bronze trim; PTFE seat; stainless steel handle with plastic grip.
 - 2. Standard: MSS SP-110.
- B. Three-Piece Bronze Ball Valves with Full Port:

1. Description: Three-Piece bronze body; stainless steel ball, vented; stainless steel stem; bronze trim; PTFE seat; stainless steel handle with plastic grip.
2. Standard: MSS SP-110.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating:
 - 1) 12 inches (300 mm) and below: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.04 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

- A. Iron, Grooved-End Butterfly Valves:
1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating:
 - 1) 175 psig (1200 kPa).
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

2.05 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Nonmetallic Disc:
1. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating:
 - 1) 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B62, bronze.
 - e. Ends: Threaded.
 - f. Spring-loaded.
 - g. Disc: PTFE.

2.06 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats:
1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating:
 - 1) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Spring-loaded.
 - h. Gasket: Asbestos free.

2.07 IRON, GROOVED-END SWING CHECK VALVES

- A. Iron, Grooved-End Swing Check Valves:
 - 1. Description:
 - a. CWP Rating: 300 psig (2070 kPa).
 - b. Body Material: ASTM A536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

2.08 IRON, CENTER-GUIDED CHECK VALVES

- A. Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating:
 - 1) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - 2) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe. Handle shall be accessible from service side of valve.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Horizontal: Swing Check Valve with spring return.
 - 2. Vertical Up: Swing Check Valve with spring return.
 - 3. Vertical Down: Center-Guided Check Valve.
- F. Install valve tags. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 VALVE SCHEDULE

- A. If valve applications shall be per the following:
 - 1. Shutoff Service:
 - a. NPS 2-1/2 (DN 80) and Smaller: Ball Valve.
 - b. NPS 3 (DN 65) and Larger: Butterfly Valve.
 - 2. Drain valves: Ball Valve.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

Service	Butterfly Valve		Ball Valve		Pump Check Valve		Pipe Check Valve		Grooved End	
	2-1/2 inch and below	3-inch and above	2-1/2 inch and below	3-inch and above	2 inch and below	2-1/2-inch and above	2-1/2 inch and below	3-inch and above	2-1/2 inch and below	3-inch and above
HHW	N/A	Iron, CWP 150	Bronze, CWP 600	N/A	Bronze, swing, class 150	Iron, center guided, class 150	Bronze, swing, class 150	Iron swing, class 125	N/A	N/A

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Metal framing systems.
 4. Thermal-hanger shield inserts.
 5. Fastener systems.
 6. Pipe stands.
 7. Equipment supports.
- B. Related Sections:
 1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 2. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
 3. Section 23 31 00 "HVAC Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
- B. All mechanical equipment shall be anchored or braced to meet the horizontal and vertical forces/displacements prescribed in the CBC and ASCE/SEI 7.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified civil or structural professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Pipe stands.

- 4. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.07 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of zinc plated carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper or plastic-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of zinc plated carbon steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. B-line, an Eaton business.
 - b. Thomas & Betts Corporation; A Member of the ABB Group.
 - c. Unistrut; Part of Atkore International.
 - 2. Manufacturer shall be member of Metal Framing Manufacturers Association.
 - 3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 4. Standard: MFMA-4.
 - 5. Channels: Continuous slotted steel channel with in-turned lips.
 - 6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

8. Metallic Coating: Electroplated zinc.

2.04 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. National Pipe Hanger Corporation.
 2. Pipe Shields Inc.
 3. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Hydronic Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) or minimum compressive strength, 450 psig compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.07 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.08 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches
 - 2. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 3. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- G. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- H. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Elastomeric isolation pads.
 2. Flexible Pipe Connections
 3. Restrained elastomeric isolation mounts.
 4. Restrained-spring isolators.
 5. Housed-restrained-spring isolators.
 6. Pipe-riser resilient supports.
 7. Resilient pipe guides.
 8. Elastomeric hangers.
 9. Spring hangers.
 10. Restraint channel bracings.
 11. Restraint cables.
 12. Seismic-restraint accessories.
 13. Mechanical anchor bolts.
 14. Vibration isolation equipment bases.
- B. Related Requirements:
 1. Section 22 05 48 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include itemized list by equipment item indicating vibration isolation selections including manufacturer and model number. Include rated load, rated deflection, load/deflection curve, and overload capacity for each vibration isolation device.
 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Vibration isolation hardware must not be concealed until approval is obtained from the owner's field representative.
- F. Verify specified clearances; plumb installation of hanger rods and lack of interference (e.g., no contact is permitted with gypsum board, framing, ceiling wires, conduit, ducts, and piping).
- G. Verify proper vibration isolator loading and deflection.
- H. Vibration isolation supplier to generate punch list report for Construction Administrator's review.
- I. Operational and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.
- J. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- K. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Perform Work in accordance with ASHRAE Handbook Chapter 47, SMACNA recommendations, and standards and recommendations of ASHRAE 68.

1.07 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and vibration isolation treatments defined in this section. Record actual locations of hangers including attachment points, loads and static deflection at time of building handover.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.09 WARRANTY

- A. Furnish one year manufacturer warranty for mounts and bases.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Wind load shall be determined per ASCE 7, basic wind speed equal to 100mph, exposure category C.
 - 2. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Seismic forces shall be determined by ASCE7
 - a. Site Class as Defined in the CBC: B.
 - 2. Assigned Seismic Risk Category: III.
 - a. Component Importance Factor: 1.0
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): refer to drawing S/S-001.
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: refer to drawing S/S-001.
 - 5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 6. Provide vibration isolation on motor driven equipment, plus connected piping as specified in this section and as scheduled within the Drawings.
 - a. Determine system weight, load reactions, center of gravity, building capacity to accept loads, and support mechanisms.
 - b. Provide building structure engineer with required loads and forces required to support and restrain installation.
 - c. Provide isolation and anchorage equipment, including anchors.
 - d. Vibration isolators shall operate in the linear portion of their load versus deflection curve. The curve shall be linear over a deflection range of not less than 50% above the design deflection. The ratio of lateral to vertical stiffness shall be neither less than 0.8 nor greater than 1.5.

- e. Vibration isolators shall be non-resonant with equipment forcing frequencies or support structure natural frequencies.
 - f. Provide minimum static deflection of isolators for equipment as indicated on the mechanical schedules.
7. Use concrete inertia bases for fans and on base mounted pumps or as scheduled in the Drawings.

2.02 MATERIALS

- A. Isolators shall be selected by the supplier based on the static and dynamic loads supported. Dynamic loads include those due to: wind, fluid flow, thrust, and rotational inertia. Select each isolator independently for the load distribution on the equipment base, duct, or pipe support.
- B. Vibration isolators shall have either known height without a load, or other markings so that after adjustment, when fully loaded, the deflection can be verified.
- C. All static deflections are nominal and actual installed deflections are to be $\pm 15\%$ of the specified value.
- D. All spring isolators shall be laterally stable and have leveling bolts. Spring isolators shall have a minimum additional "travel" to full compression of half the rated deflection. The ratio of lateral to vertical stiffness shall be 0.9 minimum and 1.5 maximum.
- E. Provide all floor-mounted spring isolators with mounting base plates that provide for bolting to the floor and incorporate 3/4-inch-thick Class "E" neoprene bearing pads. Where neoprene bearing pads provided with spring isolators are less than 3/4-inch-thick, provide additional resilient pad(s) to achieve an overall thickness of 3/4-inch, minimum.
- F. Spring isolation hangers shall incorporate a resilient neoprene element of 1/4-inch minimum thickness to prevent solid contact between the spring and isolator housing.
- G. Equipment requires a minimum of four isolators, one at each corner.
- H. Provide thrust restraints on fans over 3 inches w.g. static pressure. Thrust restraints shall have the same deflection as isolators supporting the fan.
- I. Confirm suitability of vibration isolation system with equipment manufacturers wherever necessary.
- J. Equipment support frames and bases shall be selected by the supplier in order to use the specified isolators.
- K. All vibration isolators installed outdoors shall use EPDM or equivalent elastomeric elements in place of neoprene. All metal parts are to be factory primed and painted.
- L. All neoprene material to have anti-ozone and anti-oxidant additives.
- M. Snubbers must not limit the vibration isolation capability during normal operation. Where steel limit stops are used, provide 1/4-inch-thick neoprene to prevent metal-to-metal contact.
- N. Where indicated, slack cable restraints are to be installed at each isolator. Size slack cables and anchors to support entire equipment load. Isolators located at the corners of equipment require two slack cables perpendicular to one another in the horizontal plane. The allowable equipment movement must be restricted to prevent springs from disengaging their mountings.

2.03 MANUFACTURER

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. California Dynamics Corp.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Vibration Mountings & Controls, Inc. (Vibrex)

2.04 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: P1.
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 2. Size: Factory or field cut to match requirements of supported equipment.
 3. Pad Material: Oil and water resistant with elastomeric properties. Thickness shall be 3/4-inch. The pads shall be 40-50 durometer and selected for 40-50 psi loading and selected for 0.125-inch deflection.
 4. Surface Pattern: Ribbed or Waffle pattern.
 5. Infused nonwoven cotton or synthetic fibers.
 6. Load-bearing metal plates adhered to pads.
 7. Sandwich-Core Material: Resilient and elastomeric.
 8. Acceptable Products:
 - a. Mason, Type SW
 - b. Kinetics, Type NGB
 - c. Vibrex, Type ISO-Cube.

2.05 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: RS-1.
1. Basis of Design: Mason SLR
 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top plate with threaded mounting holes, elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
 - d. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - e. Code: Color code springs for load carrying capacity.
 - f. Springs: Spring diameter shall be no less than 0.8 of the compressed height of the spring at design load.
 3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch (1.2 mm); meet requirements for neoprene pad isolators.
 5. Restraint: Furnish mounting frame and limit stops. A minimum 1/2 inch clearance shall be maintained around the restraint bolts, housings, and springs so as not to interfere with the spring action.
 6. Restraint: Limit stop as required for equipment and authorities having jurisdiction. Use neoprene grommets around the restraining bolts to prevent metal-to-metal contact.
 7. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 8. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 9. Lateral Stiffness: More than 90 percent of rated vertical stiffness.
 10. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.06 PIPE SLEEVES

- A. Resilient Pipe Sleeves: RPS1
 - 1. Manufacturer:
 - a. Porter-Roemer
 - b. Stoneman Engineering
 - c. Or approved equal.
 - 2. Resilient Pipe Sleeve at Support or Construction Penetration: Sleeve shall consist of a formed and stiffened galvanized steel sleeve lined on the inside with moisture and vermin resistant felt bonded to the metal sleeve and 1/2-inch thick. Sleeve inside diameter shall equal pipe outside diameter in each application. Sleeve shall be split longitudinally so it can be snapped over pipes and reclosed without damage. Sleeve lengths shall be as recommended by the manufacturer for the given diameters, but shall not be less than 3 inches.

2.07 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 3/4-inch- (13-mm-) thick neoprene: RPAG1.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.08 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 3/4-inch- (13-mm-) thick neoprene: RPAG2.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.09 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: H1.
 - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact, capable of 0.20-inch static deflection

2.10 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: H2.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 90 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Adjustable Vertical Stop: Steel washer with neoprene washer “up-stop” on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

B. Pre-compressed Spring Hanger: H3

1. Pre-compressed Spring Hanger delivered pre-compressed to their planned installed deflection to keep pipes or equipment steady during installation. Hangers shall be designed with a slow-release mechanism to free the spring after installation is complete and the spring is fully loaded. Vibration isolation hangers shall contain a laterally-stable steel spring set in a neoprene cup manufactured with a bushing to prevent short-circuiting of the hanger rod as it passes through the hanger housing. Spring diameters and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the housing. Great care shall be taken to see that all springs are free to oscillate 0.25". Deflection shall be clearly indicated by means of a scale.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant neoprene minimum 1/4 inch thick and maximum 50 durometer. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame designed to properly distribute the spring load on the neoprene and prevent its crushing.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.11 SEISMIC-RESTRAINT DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide M.W. Saussé or a comparable product by one of the following:
 1. Amber/Booth Company, Inc.
 2. Cooper B-Line, Inc.; a division of Cooper Industries
 3. Hilti, Inc.
 4. Kinetics Noise Control
 5. Mason Industries
 6. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES .
- C. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Channel Brace: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

- F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- G. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- K. Type I, Equipment Not Vibration Isolated
 - 1. Attach to the structure in accordance with the requirements of IBC
- L. Type II, Vibration Isolated Equipment
 - 1. Mount all vibration isolated equipment on rigid steel frames as described in the vibration control specifications unless the equipment manufacturer certifies direct attachment capability.
 - 2. Each isolated frame shall have a minimum of four all directional seismic snubbers located as close to the vibration isolators as possible.
 - 3. Seismic Snubbers:
 - a. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
 - b. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
 - c. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
 - 4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.
 - 5. The snubbers shall contain an elastomeric neoprene one-piece bushing that is replaceable and a minimum of 1/4 inch thick. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch. The neoprene bushing shall be capable of rotation to verify that no short circuiting of the vibration isolator exists. Shim snubbers as required to maintain clearances.
 - 6. The snubber end cap shall be removable for inspection of snubber internal clearances.
- M. Type III, Seismic Restraint of Suspended Piping
 - 1. Support all piping and ductwork systems per SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" and 2019 California Building Code.
 - 2. Provide restraints for all trapeze mounted piping where the total supported weight is greater than or equal to a 2-1/2 inch pipe, except in equipment rooms where all trapeze mounted piping weight is greater or equal to 1-1/4 inch pipe.
 - 3. Provide restraints for all piping 1-1/4 inch and larger located in boiler rooms, mechanical equipment rooms and refrigeration machinery rooms.
 - 4. Provide restraints for all fuel gas and oil piping, medical gas piping and compressed air piping 1 inch and larger.
 - 5. Cable shall be installed with sufficient slack to avoid short circuiting the vibration isolation.
- N. Type IV, Suspended Equipment
 - 1. Utilize a slack cable restraint system.
 - 2. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolation.

2.12 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.13 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.14 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: BS-1
 1. Factory-fabricated, welded, structural-steel rails.
 2. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.
 3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
 4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

- B. Steel Bases: BS-2
 1. Basis of Design: Mason "ICS", Kinetics "SSRB," or equal
 2. Construction: Factory-fabricated, welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.
 3. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 4. Base depth shall be at least one-tenth the longest dimension of the base, but not more than 12 inches
 5. Members shall be rigid to prevent twist, rack, deform or deflect in any manner that will generate stress in the equipment, or degrade the performance of isolation mount.
 6. Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 7. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
 8. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

- C. Concrete Inertia Base: BS-3
 1. Basis of design: Mason type K.
 2. Mass: Minimum of 1.5 times weight of isolated equipment.
 3. Construction: Factory fabricated structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
 4. Connecting Point: Reinforced to connect isolators and snubbers to base.
 5. Concrete: Reinforced 3,000 psi (20 MPa) concrete.
 6. Bases for pumps shall be large enough to provide support for suction and discharge elbows.

7. The base depth shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity.
8. Forms shall include minimum concrete reinforcement consisting of half-inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations.
9. Height saving brackets shall be employed in all mounting locations to maintain a minimum 2 inch clearance below the base.
10. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
11. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
12. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
13. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.15 FLEXIBLE CONNECTORS:

- A. Flexible connections for the air distribution system shall be fabricated from glass fabric coated with neoprene or other approved material and weighing a minimum 30 oz. per square yard. The minimum clear dimension of the flexible connectors, not including the clamping section, shall be 6 inches.
- B. Flexible connectors for HVAC piping systems shall be rated for operating pressure, temperature and fluid type. At water piping, provide:
 1. Inside diameter 2-1/2 inches and larger: Mason Type Safeflex SFDEJ or equal.
 2. Inside diameter 3/4 inch to 2 inches: Mason Type MFTFU or equal.
 3. Inside diameter 1/2 inch: Mason Type RMM or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Isolate all pipes attached to the inlet and discharge of spring-isolated equipment and pressure-reducing valves using the same isolator type and static deflection as the equipment isolators within the mechanical room or 50 feet (whichever is greater) from the inlet and discharge.
- B. Isolate the remainder of horizontal pipe runs 2-in in diameter and greater using Type NM or NH isolators.
- C. All vertical risers for piping 2-in diameter or greater shall be isolated from the building structure by means of guides, supports, and spring isolators. The support systems shall be an engineered solution taking into account pipe movement, expansion and vibration isolation.
- D. All vertical risers for piping less than 2-in diameter shall be isolated from the building structure by Type NM neoprene mount below flanges or pipe clamps. Where fixing to structure is required, neoprene isolator bushings shall be used to provide resilient support.
- E. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."
- F. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- G. Do not use vibration isolation components to straighten or connect misaligned sections of piping or ductwork.
- H. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- I. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- J. Install cables so they do not bend across edges of adjacent equipment or building structure.
- K. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- L. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- M. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- N. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- O. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.
- P. Install isolation for motor driven equipment.
- Q. Bases:
1. Set steel bases for 1 inch (25 mm) clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2 inch (50 mm) clearance between housekeeping pad and base.
- R. General
1. Adjust equipment level.
 2. Install spring hangers without binding.
 3. Provide a minimum of 1" clearance between the building structure (walls, floors, and ceilings) and vibration isolated supports, ducts, pipes, and equipment.
 4. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
 5. Provide pairs of thrust restraint horizontal limit springs on fans based on static pressure as scheduled.
 6. Do not use vibration isolation components to straighten or connect misaligned sections of piping.
 7. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting pipes.
 8. The installation or use of vibration isolators must not cause any change in position of equipment or piping ducts that result in stresses in any connections or misalignment of shafts or bearings. Equipment shall be maintained in a rigid position during installation. The load shall not be transferred to the isolators until the installation is complete and in operational condition.
 9. Do not install any plumbing equipment or piping that makes rigid contact with the "building" unless it is approved in this specification or by the Engineer. "Building" includes, but is not limited to, slabs, beams, columns, walls, partitions, ceilings, studs, ceiling framing, and suspension systems. Resiliently-isolated piping shall not contact building construction or other equipment or items.
 10. Align isolation hanger rods to clear the hanger box under all operating conditions.
 11. Level vibration isolated equipment under rated design operating conditions while maintaining the isolation criteria. Isolators shall be plumb and aligned to preclude misalignment or undesired contact during operation.
- S. Flexible Pipe Connections:
1. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
 - a. Use flexible double sphere neoprene pipe connectors for connections to pumps on vibration isolators.

- b. Use flexible wire braided connectors on branch connections to heat transfer equipment.
- 2. Install flexible connectors to accommodate displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

T. Piping Supports

- 1. Isolate all pipes attached to the inlet and discharge of spring-isolated equipment and pressure-reducing valves using the same isolator type and static deflection as the equipment isolators within the mechanical room or 50 feet (whichever is greater) from the inlet and discharge.
- 2. Isolate the remainder of horizontal pipe runs 2-in in diameter and greater using Type NM or NH isolators.
- 3. All vertical risers for piping 2-in diameter or greater shall be isolated from the building structure by means of guides, supports, and spring isolators. The support systems shall be an engineered solution taking into account pipe movement, expansion and vibration isolation.
- 4. All vertical risers for piping less than 2-in diameter shall be isolated from the building structure by Type NM neoprene mount below flanges or pipe clamps. Where fixing to structure is required, neoprene isolator bushings shall be used to provide resilient support.

U. HVAC PIPING VIBRATION ISOLATION SCHEDULE

Description	Design Deflection	Isolator Type	Seismic Restraint
Main Horizontal Runs	N/A	RPS1	III
Suspended within Mechanical Room	1.0"	H3	III
Floor Supported	1.0"	S1	-
Main Vertical Risers	N/A	RPAG1, RPAG2	N/A

- 1. Limit fluid velocities in pipes as follows:
 - a. 2" diameter piping and smaller – 4 f.p.s. maximum
 - b. Piping larger than 2" diameter – 6 f.p.s. local to condominiums and guestrooms, 10 f.p.s. maximum elsewhere.

V. HVAC EQUIPMENT VIBRATION ISOLATION SCHEDULE

Equipment Mark	Design Deflection	Isolator	Frame	Seismic Restraint
		Type	Type	Type
Air to water Heat Pumps	2.0"	RS1	-	II
Pumps (5HP and above on level 1)	2.0"	RS1	BS2 / BS3	II
All other Pumps	1.5"	RS1	BS2 / BS3	II
Air Handling Unit supply and return fans (internal)	2.0"	RS1	-	II
Internally isolated Air Handling Unit external vibration isolation	0.06"	P1	BS2	I
Hung Fans (> 300 RPM)	3.5"	H2	-	IV
Hung Fans (301-450 RPM)	3.0"	H2	-	IV
Hung Fans (CFM ≥ 2,000 or 451-751 RPM)	2.0"	H2	-	IV
Hung Fans (CFM < 2,000 or < 751 RPM)	1.0"	H2	-	IV
Fans (> 300 RPM)	3.5"	RS1	BS2	II
Fans (301-450 RPM)	3.0"	RS1	BS2	II
Fans (CFM ≥ 2,000 or 451-751 RPM)	2.0"	RS1	BS2	II
Fans (CFM < 2,000 or < 751 RPM)	1.0"	RS1	BS2	II
Fan Coil Units	1.0"	RS1	-	II
Condensing Units	1.5"	RS1	BS-1	II

1. Frame may be omitted if a written undertaking can be obtained from equipment manufacturer, stating that factory-supplied frame will be suitable for isolator point-loading and will be adequate seismically, per local Code requirements.
2. Where type RS1 spring mounts with vertical travel limit stops are specified, seismic snubbers may be omitted if a Licensed Structural Engineer verifies that limit stop on RS1 mount will provide sufficient seismic restraint to conform with local Code requirements.
3. Provide seismic restraint calculations for all connections of equipment to support structure.
4. Use flexible, duct, pipe and conduit at connections to all vibration isolated equipment.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least [four] of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.
- E. Testing of systems/equipment specified in this Section shall be coordinated, scheduled, and documented in accordance with the requirements of Section 019113 – General Commissioning Requirements.

3.05 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of sprint isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Duct labels.
 5. Valve tags.
 6. Warning tags.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Craftmark
 - d. Seton Identification Products.
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
 3. Letter Color: Black.
 4. Background Color: White.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 8. Fasteners: Pair of Stainless-steel rivets or self-tapping screws. Where equipment is installed in piping utilize a pair of chains.

- B. Label Content: Include building number or designation and equipment's unique equipment number.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Craftmark
 - 4. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch 3.2 mm ((1.6 mm)) thick and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Craftmark
 - 4. Seton Identification Products.
- B. Pipe Labels: Precoiled or banded, semirigid plastic formed to cover full circumference of pipe without adhesive.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- E. Markers for underground piping: 1/8-inch thick, 3" wide, florescent yellow polyethylene tape with imprint to read "Caution – Buried Pipe Below".

- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

2.04 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Craftmark
 - 4. Seton Identification Products.
- B. Duct Labels: Banded, semirigid plastic without adhesive.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- E. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

2.05 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Craftmark
 - 4. Seton Identification Products.
- B. Description: Minimum 1-1/2-inch diameter with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Laminated three layer, double sided, plastic, engraved with black letters on light, contrasting background color, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Corrosion resistant wire-link chain or beaded chain.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.06 CEILING EQUIPMENT MARKERS

- A. Pinned 10mil vinyl 7/8-inch diameter color ceiling grid marker.

2.07 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.

3. Craftmark
 4. Seton Identification Products.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 2. Fasteners: Reinforced grommet and wire or string.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean ducts, piping, and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Provide markers on ceiling to locate equipment above T-bar type panel ceiling. Locate in corner of panel closest to equipment. Dots shall be following colors:
1. HVAC dampers, valves and terminal boxes: Blue
 2. Plumbing Valves: Green
 3. Control Devices and Panels: Red

3.04 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 25 feet
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:

Service	Pipe Size	Type	Attachment	Background Color	Lettering Color
Heating Hot Water	Up to 6"	Pretensioned Pipe Labels	Coiled	Safety-Green	White
Condensate	All	Pretensioned Pipe Labels	Coiled	Safety-Green	White
Refrigerant (Liq/Suct)	All"	Pretensioned Pipe Labels	Coiled	Safety-Orange	Black

3.05 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with bands on all air ducts in the following color codes:
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system. Identify air handling unit number at each location.
 - 1. Near each terminal device or group of devices.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each duct at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed ducts.
 - 5. Near major equipment items and other points of origination and termination.
- C. Duct Label Color Schedule: revise table to suit project.

Service	Pipe Size	Type	Attachment	Background Color	Lettering Color
Duct – Supply	All	Plastic Label	Banded	Safety-Blue	White
Duct – Return	All	Plastic Label	Banded	Safety-Blue	White
Duct – Exhaust/Relief	All	Plastic Label	Banded	Safety-Blue	White
Duct – Outside Air	All	Plastic Label	Banded	Safety-Blue	White

3.06 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
 - 1. On the as-built drawings, indicate the location and number of each tagged valve.
 - 2. Provide a computer file database describing the valve, number, location, type of service normally “open” or “closed”, specific duty of each tagged valve, and manufacturer and model number.
 - 3. Wherever charts, Shop Drawings, etc. Refer to specific room numbers, use room numbers that will be provided by the client rather than the room numbers indicated on the Drawings.

- B. Valve-Tag Application Schedule: Tag valves according to color scheme and with captions similar to those indicated in the following subparagraphs:
- C. Valve-Tag Colors:
 - 1. Potable and Other Water: White letters on a safety-green background.
 - 2. All services not listed above: white letters on a safety-black background

3.07 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters. See Section 3320, Article 7, Subchapter 7, General Industry Safety Orders, Title 8, California Code of Regulations.
- C. Fire dampers and fire smoke dampers: at each fire damper or fire smoke damper access panel, label "FIRE DAMPER" or "FIRE SMOKE DAMPER" in minimum 1 inch (25 mm) high letters. Fire smoke dampers shall be provided with tags to identify each fire smoke dampers with 2 lines as follows: the first line "FSD-NUMBER SEQUENCES-BLDG NUMBER" (e.g. FSD-001-15). The second line "ZONE FIRE ALARM-zone" that activates the damper (e.g. ZONE L1-03). Tags shall be engraved plastic with white letters on red background.
- D. Underground plastic pipe markers: install 6 to 8 inches below finished grade, directly above buried pipe.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- 1. Balancing Air Systems:
 - a. Variable-air-volume systems.
- 2. Balancing Hydronic Piping Systems:
 - a. Variable-flow hydronic systems.
- 3. Control system verification

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.04 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.05 ACTION SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Air-Balance Report: Documentation indicating that Work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
 - 2. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.07 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC or NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.08 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.
 - f. Control valves are functioning per the sequence of operation.
 - g. Shutoff and balance valves have been verified to be 100 percent open.
 - h. Pumps are started and proper rotation is verified.
 - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - j. Variable-frequency controllers' startup is complete and safeties are verified.
 - k. Suitable access to balancing devices and equipment is provided.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and ASHRAE 111 and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.
- E. Report shall include the as-found condition, all iterative balancing measurements, as well as the final balanced state.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.

- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 23 31 00 "HVAC Metal Ducts."

3.05 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
 - 1. Check liquid level in expansion tank.
 - 2. Check highest vent for adequate pressure.
 - 3. Check flow-control valves for proper position.
 - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - 5. Verify that motor starters are equipped with properly sized thermal protection.
 - 6. Check that air has been purged from the system.

3.06 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

3.07 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following at the controls interface level and at the dashboard level:
 - 1. Verify temperature control system is operating within the design limitations.
 - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 - 3. Verify that controllers are calibrated and function as intended.
 - 4. Verify that controller set points are as indicated.
 - 5. Verify the operation of lockout or interlock systems.
 - 6. Verify the operation of valve and damper actuators.
 - 7. Verify that controlled devices are properly installed and connected to correct controller.
 - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.08 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Relief, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Hydronic Systems Water Flow Rate: Plus or minus 10 percent.

- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.09 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

3.11 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner's Representative.
- B. Owner's representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 3. If the second verification also fails, Owner's representative may contact AABC Headquarters regarding the AABC National Performance Guaranty.

- F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

**SECTION 23 0713
HVAC DUCT INSULATION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Duct insulation.
 - 2. Acoustical duct lagging.
 - 3. Insulation jackets.
- B. Related Sections:
 - 1. Division 01 – Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Division 07 – Firestopping.
 - 3. Division 09 – Painting and Coating: Painting insulation jackets.
 - 4. Section 23 05 53 – Identification for HVAC Piping and Equipment.
 - 5. Section 23 31 00 – HVAC Metal Ducts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- B. ASTM B209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- C. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- D. ASTM C553 – Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- E. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- F. ASTM C916 – Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).
- G. ASTM C1071 – Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.
- H. ASTM C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.
- I. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- J. ASTM E96/E96M – Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- K. ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2013.
- L. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

- M. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 ACTION SUBMITTALS

- A. See Division 01 and Section 23 00 00 “HVAC General Requirements” for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
 - 1. Coefficients in each octave band from 63Hz to 8000Hz
 - 2. Acoustic testing reports
- C. Manufacturer’s Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved. Include details for removable insulation sections at access panels.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum five (5) years of experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer’s identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping. Any insulation subjected to moisture shall not be used.
- C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Requirements for all products of this section:
 - 1. Surface Burning Characteristics:
 - a. Indoor insulation: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.
 - b. Outdoor insulation: Flame spread/Smoke developed index of 75/150, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.
 - 2. Products shall not contain PVC, asbestos, lead, mercury, or mercury compounds.
 - 3. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
 - 4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
 - 5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.02 INSULATION MATERIALS

- A. Glass fiber, flexible:
 - 1. Manufacturer:
 - a. Knauf Insulation.
 - b. Johns Manville Corporation.
 - c. Owens Corning Corporation.
 - d. CertainTeed Corporation.
 - 2. Insulation: ASTM C553; flexible, noncombustible blanket with a thermosetting resin.
 - a. Density / Thermal Conductivity ('K' value):
 - 1) 0.75 pcf / K = 0.36 at 75 deg F, when tested in accordance with ASTM C518.
 - 2) 1.0 pcf / K = 0.33 at 75 deg F, when tested in accordance with ASTM C518.
 - 3) 1.5 pcf / K = 0.31 at 75 deg F, when tested in accordance with ASTM C518.
 - b. Maximum Service Temperature: 250 deg F (121 deg C), tested by ASTM C411.
 - c. Maximum Water Vapor Sorption: 5.0 percent by weight.
- B. Glass fiber, rigid:
 - 1. Manufacturer:
 - a. Knauf Insulation.
 - b. Johns Manville Corporation.
 - c. Owens Corning Corp.
 - d. CertainTeed Corporation.
 - 2. Insulation: ASTM C612; rigid, noncombustible board.
 - a. Density / Thermal Conductivity ('K' value):
 - 1) 1.6 pcf / K = 0.24 at 75 deg F, when tested in accordance with ASTM C518.
 - 2) 3.0 pcf / K = 0.23 at 75 deg F, when tested in accordance with ASTM C518.
 - 3) 6.0 pcf / K = 0.22 at 75 deg F, when tested in accordance with ASTM C518.
 - b. Maximum service temperature: 450 deg F (232 deg C).
 - c. Maximum Water Vapor Sorption: 5.0 percent.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- D. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm (0.009 metric perm)at 43-mil (1.09-mm)dry film thickness.
 - 2. Service Temperature Range: -20 to +180 deg F (-29 to +82 deg C).

3. Solids Content: ASTM D1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

2.05 SEALANTS

- A. General Properties:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: -40 to +250 deg F (-40 to +121 deg C).
- B. FSK and Metal Jacket Flashing Sealant Color: Aluminum.
- C. ASJ Flashing Sealant Color: White.

2.06 ACOUSTICAL DUCT LAGGING

- A. Manufacturers:
 1. Sound Seal
 2. Acoustical Surfaces
 3. Kinetics KNM
 4. Or equal.
- B. Foil-faced vinyl flexible noise barrier.
- C. Surface-Burning Characteristics: maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to ASTM E84.
- D. Temperature: Rated up to 180 deg F.
- E. Acoustic performance:

	Octave Band Frequencies (Hz)					
	125	250	500	1000	2000	4000
dB	15	18	22	27	32	37

- F. Lagging adhesives: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 3. Service Temperature Range: 0 to +180 deg F
 4. Color: White.

2.07 DUCT LINER

- A. General Requirements:
 1. No fiberglass duct liner is allowed.
 2. Service temperature: -20 °F to 250 °F (-29 °C to 120 °C).
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 4. NFPA 90A and NFPA 90B compliant.
 5. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 6. Passes UL181, ASTM G21/G22 and C1338 for bacterial, fungi resistance and mold growth.
- B. Polyester based Duct Liner:
 1. Manufacturers:

- a. Ductmate PolyArmor
- b. Or approved equivalent.
- 2. K value: ASTM C518, 0.238 at 75 deg F; R-value per inch: 4.2.
- 3. Minimum Noise Reduction Coefficient (NRC): 0.65 at 1 inch thickness.
- 4. Maximum moisture sorption: 0.24% by volume.
- 5. Sound absorption coefficients:

Frequency	63hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
Thickness (1-inch)	0.1	0.15	0.37	0.88	0.95	0.48	0.24	0.18
Thickness (2-inch)	0.2	0.27	0.77	1.00	0.87	0.51	0.34	0.20

- 6. Mechanical Fasteners:
 - a. Suitable for attachment to duct without damaging liner as recommended by manufacturer.
 - b. Pin length: as required. Pin shall project no more than 1/8 inch into air stream.
- C. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.08 JACKETS

- A. All Service Jacket (ASJ): ASTM C1136.
 - 1. Vapor retarder laminate of reinforced bleached white kraft / foil.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- B. Foil and Paper Jacket (FSK): ASTM C1136.
 - 1. Vapor retarder laminate of foil / scrim / kraft construction.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- C. Accessories:
 - 1. Bands: 3/4 inch wide.
 - 2. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 3. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been pressure tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Install in accordance with manufacturer's instructions.
- C. Install in accordance with NAIMA National Insulation Standards.
- D. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and/or bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- K. Apply insulation with the least number of joints practical.
- L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Where service access is required, provide removable insulation sections that allow for removal and replacement without damaging surrounding insulation. At nameplates, bevel and seal ends of insulation. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- M. Hangar Inserts.
 - 1. For support points of rectangular or oval ducts supported by trapeze hangers, place weight supporting insulation at bottom of duct over trapeze. Weight supporting insulation shall be rigid glass fiber insulation having minimum of 6 pcf density and 200 lb/ft compression strength at 10% deformation and minimum 6" long with same thickness as insulation specified. Weight supporting inserts similar to HAMFAB H-block by ICA Inc. may be used for rectangular ducts less than 18". Follow manufacturer's recommendation for number of inserts.
 - 2. For support points of round ducts smaller than 16" diameter, weight supporting insulation is not required for either rigid or flexible glass fiber insulation.
 - 3. For support points of round ducts 16" diameter and larger, place weight supporting insulation between duct and strap or trapeze.
 - 4. Flexible glass fiber insulation may be installed outside of support for round ducts 24" diameter or smaller, provided vapor barrier integrity is maintained at rod / strap penetration.
 - 5. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- N. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

- O. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- P. Cut and install insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- Q. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples or tape.
 - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.04 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces or as recommended by insulation manufacturer.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation more than 75% during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces or as recommended by insulation manufacturer..
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.05 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.06 FIELD QUALITY CONTROL

- A. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [one] location(s) for each duct system.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.07 SCHEDULES

- A. Items Not Insulated:
 1. Double-wall metal ducts which comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.
 7. Supply Ductwork exposed in directly conditioned space
 8. Return air ducts concealed in conditioned space or shaft
 9. Transfer air ducts.
- B. Location definitions:
- C. Concealed: ductwork in ceilings and shafts.
 1. Exposed: ductwork that is not concealed, but also not in occupied spaces such as ductwork in mechanical rooms.
 2. Occupied: ductwork in occupied and conditioned rooms.

Type	Location	Insulation	Minimum Thickness	Jacket
Supply	Concealed	Fiber Board 1.6pcf	1.5 inch	None
		Duct lining	1 inch minimum ¹	
		Fiber Wrap 0.75pcf	1.5 inch	
	Exposed up to 8' AFF	Fiber Board 3.0pcf	1.5 inch	None
		Duct lining	1 inch minimum ¹	Alum
		Fiber Wrap 0.75pcf	1.5 inch	Alum
	Exposed above 8' AFF	Fiber Board 1.6pcf	1.5 inch	None
		Duct lining	1 inch minimum ¹	
		Fiber Wrap 0.75pcf	1.5 inch	
Return	Exposed up to 8' AFF	Fiber Board 3.0pcf	1.5 inch	None
		Duct lining	1 inch minimum ¹	Alum
		Fiber Wrap 0.75pcf	1.5 inch	Alum
	Exposed above 8' AFF	Fiber Board 1.6pcf	1.5 inch	None
		Duct lining	1 inch minimum ¹	
		Fiber Wrap 0.75pcf	1.5 inch	

1. Provide 2" lining where indicated on drawings.
2. Internally lined ducts do not require external insulation.

Table: DUCT INSULATION

END OF SECTION

**SECTION 23 0716
HVAC EQUIPMENT INSULATION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
 1. Chilled-water pumps.
 2. Heating, hot-water pumps.
 3. Expansion/compression tanks.
 4. Air separators.
- B. Related Sections:
 1. Section 230713 "Duct Insulation."
 2. Section 230719 "HVAC Piping Insulation."

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Sustainable Design Submittals:
 1. Product Data: For adhesives, indicating VOC content.
 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 3. Product Data: For coatings, indicating VOC content.
 4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
 5. Product Data: For sealants, indicating VOC content.
 6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail removable insulation at equipment connections.
 3. Detail application of field-applied jackets.
 4. Detail application at linkages of control devices.
 5. Detail field application for each equipment type.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
- H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- 1. Adhesives shall have a VOC content of 50 g/L or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.

- b. Eagle Bridges - Marathon Industries.
- c. Foster Brand; H. B. Fuller Construction Products.
- 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. VOC Content: 300 g/L or less.
 - 2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.04 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
 - 2. Adhesives shall have a VOC content of 50 g/L or less.
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
 - 5. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 - 6. Color: White.

2.05 SEALANTS

- A. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. ASJ Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 2. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.08 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal.
- B. Insulation Pins and Hangers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.
 - 2) CL WARD & Family Inc.
 - 3) Midwest Fasteners, Inc.
 - 4) Nelson Stud Welding.
 2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing

insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches (75 mm).
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from aluminum, at least 0.050 inch (1.3 mm) thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.05 FINISHES

- A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.07 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Chilled-water pump insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
- C. Heating-hot-water pump insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
- D. Heating-hot-water buffer and expansion/compression tanks insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 1 inch (25 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
 - 2. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
 - 3. Flexible Elastomeric: 1 inch thick.
- E. Heating-hot-water air-separator insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
 - 2. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

END OF SECTION

**SECTION 23 0719
HVAC PIPING INSULATION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 1. Condensate drain piping, indoors.
 2. Heating hot-water piping, indoors and outdoors.
 3. Refrigerant suction and hot-gas piping, indoors and outdoors.
 4. Heat-recovery piping, indoors and outdoors.
- B. Related Sections:
 1. Section 230713 "Duct Insulation."
 2. Section 230716 "HVAC Equipment Insulation."

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Sustainable Design Submittals:
 1. Product Data: For adhesives, indicating VOC content.
 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 3. Product Data: For coatings, indicating VOC content.
 4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
 5. Product Data: For sealants, indicating VOC contentLaboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Owens Corning.
2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Industrial Insulation Group.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
2. Adhesives shall have a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Speedline Corporation.
 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. VOC Content: 300 g/L or less.
 2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.

2. Adhesives shall have a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
5. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
6. Color: White.

2.06 SEALANTS

- A. Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: White.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Airex Manufacturing.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. P.I.C. Plastics, Inc.
 - d. Speedline Corporation.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 - 2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pittsburgh Corning Corporation.
 - b. Polyguard Products, Inc.

2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 2. Width: 3 inches (75 mm).
 - 3. Thickness: 11.5 mils (0.29 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Compac Corporation.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Venture Tape.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal.
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.08 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints. On outdoor jackets longitudinal joints shall be located on underside of pipe..

3.09 FINISHES

- A. Pipe Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (19 mm) thick.

- b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- B. Heating-Hot-Water Supply and Return, 140 Deg F (93 Deg C) and Below:
 - 1. 1" and below (DN 300) and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
 - 2. NPS 1-1/2 to NPS 12 (DN 300) and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch (25 mm) thick.
- C. Refrigerant Suction and Liquid Piping:
 - 1. NPS 3/4 and smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - 2. NPS 1 and larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1-1/2 inch (25 mm) thick.
- D. Refrigerant Hot-Gas Flexible Tubing (2 pipe systems):
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1-1/2 inch (25 mm) thick.
- E. Heat-Recovery Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 140 Deg F (93 Deg C) and Below:
 - 1. 1" and below (DN 300) and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
 - 2. NPS 1-1/2 to NPS 12 (DN 300) and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch (25 mm) thick.
- B. Refrigerant Suction and Liquid Piping:
 - 1. NPS 3/4 and smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - 2. NPS 1 and larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1-1/2 inch (25 mm) thick.
- C. Refrigerant Hot-Gas Piping (2 pipe systems):
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1-1/2 inch (25 mm) thick.
- D. Heat-Recovery Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

3.14 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, All Sizes, 200 Deg F (93 Deg C) and Below: Cellular glass, 3 inches (75 mm) thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Concealed:
 - 1. None.
- C. Piping, Exposed in occupied spaces:
 - 1. PVC: 30 mils (0.8 mm) thick.
- D. Piping, Exposed in mechanical rooms, all pipe below 8 feet from finish floor:

1. None.
 2. PVC: 30 mils (0.8 mm) thick.
- E. Piping, Exposed in mechanical rooms above 8 feet above finish floor:
1. None **OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Concealed:
1. None.
- C. Piping, Exposed:
1. Stainless Steel, Type 304 or 316, Smooth 2B Finish with Z-Shaped Locking Seam:
0.016 inch (0.41 mm) thick.
- 3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET**
- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 23 0800**COMMISSIONING OF HVAC AND PLUMBING****PART 1 - GENERAL****1.01 DESCRIPTION**

- A. The purpose of this section is to specify Division 22 and 23 responsibilities in the commissioning process which are being directed by the Commissioning Authority (CxA). The commissioning requirements designated in this section pertain to building commissioning activities and documentation in support of Calgreen Commissioning Requirements.
- B. The systems to be commissioned are listed in Division 01 "General Commissioning Requirements". Contractors MUST refer to Division 01 for this and other Commissioning information. Mechanical and Plumbing Systems Commissioning section does not replace, but instead complements, the contents of the Division 01 section and all parties shall be held to the information contained in both sections.
- C. Commissioning (Cx) requires the participation of Division 22 and 23 to ensure that all systems are operating in a manner consistent with the Contract Documents through documented functional testing and startup procedures. The general commissioning requirements and coordination are detailed in Division 01. Division 22 and 23 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Commissioning Authority (CA) and shall execute all Cx responsibilities assigned to them in the Contract Documents.
- D. Systems to be Commissioned
 - 1. Chilled Water System (includes feed to heat pumps)
 - 2. Heating Hot water system
 - 3. Air Handling units (AHU-1-3)
 - 4. Supply air duct systems
 - 5. Exhaust fans
 - 6. BMS and Controls
 - 7. VAV and FAVAV terminal units
 - 8. Domestic Hot water System
 - 9. Projector Heat Relief System
 - 10. VRF systems including all fan coils and condensers
 - 11. Irrigation system
 - 12. Lighting Controls

1.02 RELATED SECTIONS

- A. Division 01 "General Commissioning Requirements".
- B. Section 25 50 00 "Building Automation System Hardware and Networking".

1.03 DEFINITIONS

- A. A/E: Architect / Engineer.
- B. BAS: Building Automation System
- C. BIM: Building Information Management.
- D. CAD: Computer Aided Design.
- E. CM/GC: Construction Manager / General Contractor.
- F. Cx: Commissioning.

- G. CxA: Commissioning Authority.
- H. CxC: CM/GC Commissioning Coordinator.
- I. FPT: Functional Performance Test(ing).
- J. HVAC: Heating, Ventilating, and Air Conditioning.s
- K. I/O: Input / Output.
- L. O&M: Operations and Maintenance.
- M. P/T: Pete’s Plug.
- N. TAB: Testing and Balancing.

1.04 RESPONSIBILITIES

- A. MECHANICAL, PLUMBING, CONTROLS, and TAB CONTRACTORS. The Cx responsibilities applicable to each of the mechanical, plumbing, controls and TAB contractors of Division 22 and 23 are as follows (all references apply to commissioned equipment only):
 1. Include and itemize the cost of Cx, including functional testing, documentation, and all specified requirements in the contract price.
 2. In each purchase order or subcontract written, include requirements for submittal data, Cx documentation, O&M data and operator training.
 3. Attend a Cx scoping meeting and other meetings necessary to facilitate the Cx process.
 4. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.
 5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of functional testing procedures.
 6. This shall include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, fan and pump curves, preliminary balance reports, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
 7. The CxA may request further documentation necessary for the commissioning process, and requests may be made prior to normal submittals.
 8. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.
 9. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 10. Provide assistance to the CxA in preparing the specific functional performance test procedures. Contractors shall review test procedures to ensure feasibility, safety, acceptability under warranty requirements, equipment protection, and provide necessary written alarm limits to be used during the tests.
 11. During the startup and initial checkout process, execute the pre-functional checklists (provided by CxA) for all commissioned equipment and return to the CxA.
 12. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA for inclusion in the Commissioning Report. This may be done parallel with the pre-functional tests.
 13. Address current Architect / Engineer (A/E) punch list items before the commencement of functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
 14. Provide skilled technicians to execute starting of equipment and to rehearse and execute the functional performance tests. Ensure that they are available and present during the

- agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and all resultant problem-solving.
15. Provide skilled technicians to perform functional performance testing under the direction of the CxA for specified equipment. Contractor shall rehearse the functional tests and correct system (or identified and informed the CxA of test procedure) discrepancies from design prior to the verification tests. Assist the CxA in interpreting the monitoring data, as necessary.
 16. Provide written responses, in a timely manner, to all items noted in the Cx submittal reviews and Cx issues log that relate to Division 22 and 23.
 17. Correct any deficiencies (differences between specified and observed performance) as interpreted by the CxA, Construction Manager / General Contractor (CM/GC) and A/E and retest the equipment. Note contractor may be responsible for the cost of retesting if there are excessive test failures; see Division 01.
 18. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 19. During construction, maintain as-built red-line drawings for all drawings and final CAD as-built for contractor-generated coordination drawings. Provide to CxA as requested for functional test development and update after completion of commissioning (excluding deferred testing and seasonal testing).
 20. Provide training of the Owner's operating staff using expert qualified personnel, as specified in Division 01.
 21. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 22. Warranty Period
 - a. Assist CxA in execution of select seasonal or deferred functional performance testing.
 - b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
- B. MECHANICAL CONTRACTOR. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed are:
1. Provide startup for all HVAC equipment.
 2. Assist and cooperate with the TAB contractor and CxA by:
 - a. Review Draft Functional Performance Tests and issue comments to CxA.
 - b. Successfully rehearse Functional Performance Tests and provide a signed copy prior to CxA visit to witness test execution.
 - c. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and Cx, as required.
 - d. Including cost of sheaves and belts that may be required by TAB.
 - e. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide approved plugs to seal holes.
 - f. Providing temperature and pressure taps according to the Construction Documents for TAB and Cx testing. Note sample port (P/T or Pete's plug) requirements in hydronic details.
 - g. Install a P/T plug at each water sensor which is an input point to the control system.
 - h. List and clearly identify on the as-built drawings the locations of all air-flow stations.
 - i. Prepare a preliminary schedule for Division 22 and 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.
 - j. Notify the CxC or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the CM/GC Commissioning Coordinator or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are

executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

- k. Verify all air is bled from system and verify bleed by checking for air at 10% of manual vents no more than 3 days prior to functional testing.

C. CONTROLS CONTRACTOR. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed are:

1. To ensure an efficient delivery of the controls and analytics package during the final construction period, the BAS controls contractor shall work with Altura (Commissioning Agent) to bench test all control hardware and software before it is field deployed. Altura will provide the controls contractor with the Connected Commissioning specifications as they pertain to the BAS controls programming and bench testing. These will enable Altura to leverage the analytics-based approach to commissioning.
 - a. Expectations will include:
 - 1) Connection of typical field controllers to test typical communications and configuration.
 - 2) Altura coordinated controls point database and programming configuration that meets the latest UCSB BAS Naming Standards.
 - 3) Remote access to the bench programming.
 - 4) Availability and verification of optimization system and functional commissioning override points available to the commissioning team as specified in the Connected Commissioning specifications.
2. Programming Review – Prior to final commissioning of the controls programming into the system, the controls contractor will provide an electronic format of the field-controller level programming for Altura to review and compare to the Sequence of Operations within the design specification. This programming review allows potential issues in the programming to be identified and resolved prior to deploying the automation in the field.
3. As-Built Sequence of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, including time of day schedules, schedule frequency, and detailed point listings with ranges and initial setpoints.
4. Control Drawings Submittal
 - a. The control drawings shall have a key to all abbreviations.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list
5. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls as-built drawings submittal.
6. Assist and cooperate with the TAB contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB contractor any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
 - c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
 - d. Coordinate with the TAB contractor to acquire all balance related setpoint, for example the minimum duct pressure required at design flow and/or the pump system pressure differential required at design flow condition.

7. Assist and cooperate with the CxA in the following manner:
 - a. Review Draft Functional Performance Tests and issue comments to CxA.
 - b. Successfully rehearse Functional Performance Tests and provide a signed copy prior to CxA visit to witness test execution.
 - c. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system. Assist the CxA in interpreting the monitoring data, as necessary.
 - d. Execute all control system trend logs specified in Functional Tests. Trend data will be required in electronic format, specifically in a Microsoft Excel compatible format (ASCII text, comma delineated,.xls, etc.).
 - e. Ensure that all of the trended points are sampled at 1 minute intervals, all points may be trended simultaneously and the data is stored for all points at minimum for a 1 year period.
 - f. Provide the Commissioning Authority remote internet access to the Building Automation System during the Commissioning Period.
 8. Provide a signed and dated certification to the CxA and CM/GC Commissioning Coordinator upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.
 9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
- D. TAB CONTRACTOR. The duties of the TAB contractor, in addition to those listed are:
1. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CxA and CxC at least once a week.
 2. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
 3. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CxA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB, or ASHRAE Standard 111.
 4. Demonstrate repeatability of 10% of final air and water measurements, upon request by CxA.
 5. Provide the CxA with any requested data, gathered, but not shown on the draft reports.
 6. Provide a final TAB report for the CxA with details, as in the draft.
 7. Assist in resolving any balancing issues discovered during functional testing.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division. Refer to Division 01.

PART 3 - EXECUTION

3.01 COMMISSIONING PROCESS AND PROCEDURES

- A. Refer to Division 01 "General Commissioning Requirements" for a summary of the Commissioning process and procedures.

3.02 PRE-FUNCTIONAL CHECKLISTS

- A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this specification. Division 22 and 23 contractors have start-up responsibility and are required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures do not relieve or lessen this responsibility or shift that responsibility partially to the CxA or Owner.
- B. Review and Complete Pre-functional Checklists in accordance with Division 01.
- C. CM/GC Commissioning Coordinator (CxC) shall verify completion of all items, sign and return the checklist to the Commissioning Authority as an indication of final completion with all installation criteria as specified in the Project Contract Documents
- D. A separate completed checklist shall be submitted for each system and item of equipment within the commissioning scope of work, as specified in Division 01.
- E. The Pre-Functional Readiness Checklists do not represent all the contract documents for the associated equipment. Completion of the items on this checklist does not release the contractor from requirements specified elsewhere.

3.03 TAB REVIEW

- A. Testing, Adjusting and Balancing (TAB): TAB shall be provided by the Contractor in accordance with the project specifications. The TAB contractor shall support commissioning by submitting the preliminary TAB data for CxA review and participating on the Commissioning TAB Field Review, in which the TAB Contractor demonstrates specified results to the CxA after completion of final TAB.
- B. Equipment tested: All HVAC systems & associated equipment.
- C. Demonstrate:
 - 1. Determination of the final set points for pump speed and fan speed control per the project specifications. Demonstrate for all set points.
 - 2. Airflow rates are balanced and adjusted per the project specifications.
 - a. Demonstrate minimum outside airflow rates for all air handling equipment.
 - b. Demonstrate a 10% sample for all other measurements.
 - 3. Hydronic system flow rates are balanced and adjusted per the project specifications.
 - a. Demonstrate for all boilers, chillers, cooling towers, and distribution pumps.
 - b. Demonstrate a 10% sample for all other measurements.
 - 4. Verify TAB of circulating domestic hot water system per the project specifications. Demonstrate a 10% sample.

3.04 FUNCTIONAL PERFORMANCE TESTING

- A. The Functional Performance Test (FPT) Procedures shall be developed, performed, and demonstrated in accordance with Division 01.
- B. Contractor is responsible for conducting test runs of all required Functional Performance Tests, and submitting results to the CxA prior to the Commissioning Authority witnessed Functional Testing. See Division 01 for additional details.
- C. The initial FPTs shall be provided after review of the final and approved controls submittal. The final FPTs may be modifications of the initial FPTs, and FPTs may be added; modifications and additions to be made by the Commissioning Authority after equipment submittals have been accepted.

- D. The Contractor's Commissioning Coordinator shall coordinate the subcontractors, with the Commissioning Authority's input, in developing, performing, and demonstrating the Working FPT.
- E. Functional testing shall consist of the following four phases:
1. Component testing:
 - a. Component testing applies to all control input and output devices, including those provided by the equipment suppliers and those provided with the Building Automation System (BAS). Examples include but are not limited to: sensor assemblies, detectors, relays and switches, valves, dampers, and actuators
 - b. Component testing applies to thermometers, gauges:
 - c. Component testing consists of demonstrating field I/O calibration and operation including but not limited to:
 - 1) Accuracy of sensors is within design temperature range as specified.
 - 2) Alarmed points report correctly to operator work station.
 - 3) Accuracy and settings of binary switches and alarms is as specified, within design temperature range
 - 4) Actuators operate smoothly in a linear relationship with the signal they receive over the full range of operation
 - 5) Fail safe operation of components and controllers is as specified for loss of control signal, electric power, and network communications
 - 6) All components, values and alarms are correctly mapped to operator interface station
 - 7) Air pressure reference points appropriately located and protected from transient effects of diffusers, wind, and other localized conditions.
 2. Systems Testing; Operational Verification: After functional testing of the system components has been successfully completed, each sequence of operation and control system function shall be functionally tested, including those provided by the equipment suppliers and those provided with the Building Automation System (BAS). Each control loop shall be tested to verify stable control with the specified and appropriate responses. Testing may include examination of trended data for any point, even where not explicitly called out in functional test script.
 3. Systems Testing - Integrated System Verification: After operational testing has successfully demonstrated that each system functions in accordance with the project documents, functional testing shall occur to verify that the interaction between the systems is as required. Each interactive function shall be functionally tested, including those provided by the equipment suppliers and those provided with the BAS.
 4. Systems Testing - Real Time Performance Analysis (trend logging):
 - a. After operational testing has been successfully completed real time performance testing may be performed to further corroborate correct operation and/or verify the operation of systems that eluded the initial test phase. Data shall be logged for the intervals and periods specified in the FPT procedures. Unless otherwise specified in the FPTs, test periods shall include occupied, unoccupied, weekday and weekend schedules.
 - b. All points shall be trended, initiated at the end of construction, continuing over the entire commissioning period and left in place for future use or seasonal commissioning. All points shall be simultaneously trended per the interval specified by the CxA. Historical archiving shall be enabled so that data is continuous with no gaps and accessible in the future. The data shall be capable of being stored at a minimum of 1 year period.
 - c. Internet or web-based remote access shall be provided to the commissioning agent for the commissioning period. Trends shall be displayed graphically and shall be user configurable at the graphical interface. Graphical displays shall be capable of containing multiple points on a single graph.
 - d. Analysis of the data shall demonstrate that that the systems operate in accordance with the acceptance criteria specified in the FPT procedures. Verify that data

demonstrates acceptable results before submitting for CxA review. If acceptable results are not demonstrated, perform testing and trouble shooting and corrective action to provide resolution. Provisions for retesting, as specified in Division 01 shall apply to trend log analysis.

- e. In addition to the initial test period, data logged during a peak heating period, a peak cooling period, and a transitional season period if so specified.

3.05 ISSUE CORRECTION

- A. See Division 01 “General Commissioning Requirements”.

3.06 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. See Division 01 “General Commissioning Requirements”.

3.07 TRAINING OF OWNER PERSONNEL

- A. See Division 01 “General Commissioning Requirements”.

END OF SECTION

**SECTION 23 2113
HYDRONIC PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 1. Copper tube and fittings.
 2. Steel pipe and fittings.
 3. Joining materials.
 4. Transition fittings.
 5. Dielectric fittings.
- B. Related Sections:
 1. Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment".
 2. Section 23 07 19 "HVAC Piping Insulation".
 3. Section 23 21 16 "Hydronic Piping Specialties".
 4. Section 23 25 00 "Water Treatment".

1.03 REFERENCE STANDARDS

- A. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).
- B. ASTM D-3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 1. Pipe.
 2. Fittings.
 3. Joining materials.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Suspended ceiling components.
 2. Other building services.
 3. Structural members.
 4. Interior wall and soffit framing
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 - 3. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in preceding 6 months.
- D. The Owner's Representative reserves the right to test the work of any welder employed on the project, at the Owner's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
- B. Comply with ASME B31.9 and applicable federal, state, and local regulations.
 - 1. Heating Hot-Water Piping: 100 psig at 200 deg F.
 - 2. Makeup-Water Piping: 80 psig at 73 deg F.
 - 3. Condensate-Drain Piping: 150 deg F.
 - 4. Air-Vent Piping: 200 deg F.
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B88, Type K.
- C. DWV Copper Tubing: ASTM B306, Type DWV.
- D. Wrought-Copper Fittings and Unions: ASME B16.22.
- E. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Star Pipe Products.
 - c. Victaulic Company.
 - 2. Grooved-End Copper Fittings: ASTM B75, copper tube or ASTM B584, bronze casting.
 - 3. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, pre-lubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- F. Press Fitting: Wrought Copper Fittings: ASME B16.22.

1. Fittings shall conform to performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer.

2.03 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in “Piping Applications” Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in “Piping Applications” Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in “Piping Applications” Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, and 300 as indicated in “Piping Applications” Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 125, and 250; raised ground face, and bolt holes spot faced as indicated in “Piping Applications” Article.
- F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grinnell Mechanical Products.
 - b. Nexus Valve, Inc.
 - c. Star Pipe Products.
 - d. Victaulic Company.
 2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.04 CASED PIPING SYSTEM

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ric-Wil.
 - b. Perma-Pipe, Inc.
 - c. Rovanco Piping Systems, Inc.
 - d. Thermal Pipe Systems.
- B. Carrier Pipe: PVC, Class 160 pipe and fittings.
- C. Fittings:
 1. 8" diameter and below: Bell and spigot with lubricated rubber sealing ring.
 2. 10" and above: class 150 ductile iron flange.
- D. Carrier Pipe Insulation:
 1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
 - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
- E. Casing: HDPE.
- F. Casing accessories include the following:
 1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
 2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
 3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- G. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

2.05 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.06 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX USA LLC.
 - c. KBI (King Bros. Industries).
 - d. Viega LLC.
 - 2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX USA LLC.
 - c. KBI (King Bros. Industries).
 - d. NIBCO INC.
 - 2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.07 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- C. Dielectric Nipples: Red brass dielectric nipple.

PART 3 - EXECUTION

3.01 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves. Group piping whenever possible at common elevations.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap with retaining chain, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install air vents at all high points of the system and wherever pipe installation may cause air to become trapped.
- N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- P. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- Q. Install valves according to the following:
 - 1. Section 23 05 23 "Valves for HVAC Piping."
- R. Install unions in piping, NPS 2-1/2 (DN 65) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- S. Install flanges in piping, NPS 3 and larger, at final connections of equipment and elsewhere as indicated.
- T. Install shutoff valve immediately upstream and downstream of each dielectric fitting.
- U. Belowground HDPE:
 - 1. Field-engineered piping systems shall be fabricated from factory insulated sections of straight pipe and fittings. When practical, piping shall be provided in 40-foot double-random lengths.
 - 2. Carrier pipe joining shall be accomplished using an authorized bell and spigot or solvent weld.

3. All surfaces shall be clean and free of dirt and residue before applying to ends of pipe to be joined.
 4. Transitions to other piping materials shall be accomplished using suitable flanged or mechanical adapters.
 5. Underground systems shall be buried in a trench of not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill over the top of the pipe will meet H-20 highway loading.
 6. Trench bottom shall have a minimum of 6 inches of sand, pea gravel, or specified backfill material as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer's installation instructions.
 7. A hydrostatic pressure test shall be performed before insulating the field joints or burying the system and shall be performed per the Engineer's specifications. The factory recommended pressure test consists of an expansion phase and a test phase. Care shall be taken to insure all trapped air is removed from the system prior to the test. The expansion phase consists of an initial pressurization period of three hours at 1.5 times the normal system operating pressure. Makeup water shall be added to the system during this period to maintain the desired pressure. The test shall commence immediately after the expansion phase. The pressure shall be reduced by 10 psi and the test clock started. System pressure remaining within 5% of the target test pressure for one hour indicates no leakage has occurred. If the entire test procedure cannot be completed within eight hours of the initial pressurization, the system shall be de-pressurized and allowed to relax for a minimum of eight hours before another test is attempted. The piping system shall be restrained from uncontrolled movement in the event of a failure. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.
 8. Piping installed below grade shall be provided with means to resist hydrodynamic uplift forces. This could include, but not limited to, concrete anchors and pipe straps.
 9. Support underground piping at slab penetration. Follow manufacturer's recommendations for hanger spacing and rod size.
- V. Provide expansion loops, expansion joints, anchors, and pipe alignment guides as required to accommodate expansion.
- W. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 00 00 "HVAC General Requirements."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 00 00 "HVAC General Requirements."
- Z. Steel Pipe Nipples: Minimum 3 inches long, use of close nipples with less than 1 inch of unthreaded pipe is prohibited.
- AA. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.

3.02 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 1. Up to NPS 4Larger than NPS 4

3.03 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

- B. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Spring hangers to support vertical runs.
 3. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe, or steel hangers with felt insert.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 7 feet.
 2. NPS 1: Maximum span, 7 feet.
 3. NPS 1-1/2: Maximum span, 9 feet.
 4. NPS 2: Maximum span, 10 feet.
 5. NPS 2-1/2: Maximum span, 11 feet.
 6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.04 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.05 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gauges for HVAC Piping."

3.06 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or another source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 - 7. Verify lubrication of motors and bearings.

3.07 HYDRONIC PIPING SCHEDULE

Service	Location	Pipe Size	Material	Schedule/Type	Fittings	Joining
Heating Hot Water	Aboveground	Up to NPS 2-1/2	Copper	L	Wrought Copper	Soldered/Press-fit
			Steel	40	Malleable Iron	Threaded / Welded
		NPS 3	Steel	40	Wrought Steel	Flanged / Welded
	Mechanical Rooms	All	Steel	40	Grooved	Mechanical
	Belowground	All	HDPE 4710	DR 11	HDPE	Butt Fusion Welded
Makeup Water	All	All	Copper	L	Wrought Copper	Soldered
Condensate	All	All	Copper	K	DWV	Soldered
Air Vent	All	All	Copper	K	N/A	Flared
Safety / Relief Vent	All	All	Copper	L	DWV	Soldered

END OF SECTION

**SECTION 23 2116
HYDRONIC PIPING SPECIALTIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 1. Balancing valves.
 2. Pressure reducing valves.
 3. Relief valves.
 4. Automatic flow control valves.
 5. Air vents.
 6. Expansion tanks.
 7. Air separators.
 8. Strainers.
 9. Pressure-temperature test plugs.
- B. Related Requirements:
 1. Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
 2. Section 23 05 23 "Valves for HVAC Piping" for specification and installation requirements for valves common to most piping systems.
 3. Section 23 21 13 "Hydronic Piping".

1.03 ACTION SUBMITTALS

- A. Product Data: For each device.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.06 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- D. Protect pipe and fittings from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of the completed system.

PART 2 - PRODUCTS

2.01 BALANCING VALVES

- A. Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Bell & Gossett.
 - c. Nexus Valve.
 - d. Taco, Inc.
 - 2. Material: Bronze for copper piping systems; cast iron or steel for steel piping systems; resin plug, PTFE seat.
 - 3. Type:
 - a. NPS 2 and smaller: Ball style with flow balancing, flow measurement, and shut-off capabilities, memory stops, and NPT threaded connections. Ball shall be brass or stainless steel in bronze valves and stainless steel in cast iron or steel valves.
 - b. NPS 2-1/2
 - 4. Pressure drop: At full flow shall be the lesser of 5 psi or 10% of the hydronic loop pressure drop.
 - 5. Pressure Gauge Connections: Integral seals for portable differential pressure meter, with removeable protective cap.
 - 6. CWP Rating: Minimum 125 psig.
 - 7. Maximum Operating Temperature: 250 deg F.

2.02 PRESSURE REDUCING VALVES

- A. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Bell & Gossett.
 - c. Taco, Inc.
 - 2. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve.
 - 3. Construction: Bronze body, glass and carbon-filled PTFE disc, brass seat, EPDM O-ring stem seals, EPT diaphragm, low inlet-pressure check valve, and noncorrosive valve seat and stem. Inlet strainer shall be removeable without system shutdown.
 - 4. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.03 RELIEF VALVES

- A. Diaphragm-Operated Safety Valves: ASME labeled.
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. Conbraco Industries, Inc.
 - c. ITT Bell & Gossett.
 - d. Tyco Flow Control.
 - e. Watts
 - 2. Operation: Automatically relieves system fluid in case of overpressurization.
 - 3. Construction: Bronze body; teflon seat; stainless steel stem and springs; automatic, direct pressure actuated. Inlet strainer shall be removeable without system shutdown.
 - 4. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.04 AUTOMATIC FLOW-CONTROL VALVES

- A. Automatic Flow-Control Valves:
 - 1. Manufacturers:
 - a. Nexus Valve.
 - b. NuTech Hydronic Specialty Products.
 - 2. Operation: Maintains constant fluid flow independent of pressure changes in system.
 - 3. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.
 - 4. Construction: Brass body with union on inlet and outlet; temperature and pressure test plug on inlet and outlet with blowdown/backflush drain; brass or stainless steel valve stem; EPDM seals.
 - 5. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring, tamper-proof. Cartridge shall be replaceable without removing the valve body.
 - 6. Accessories: In-line strainer on inlet and ball valve on outlet. Ball valve: chrome plated brass or stainless steel.
 - 7. Size: Same as pipe in which installed.
 - 8. Minimum CWP Rating: 175 psig.
 - 9. Maximum Operating Temperature: 250 deg F.

2.05 AIR VENTS

- A. Manual Air Vents:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Bell & Gossett.
 - c. Taco, Inc.
 - 2. Operation: Controlled release of air at high point of hydronic system.
 - 3. Construction: Bronze body; screwdriver or thumbscrew operator; brass needle valve at top of chamber.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/8.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 225 deg F.
- B. Automatic Air Vents:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Bell & Gossett.
 - c. Taco, Inc.
 - 2. Operation: Controlled release of air at high point of hydronic system.
 - 3. Construction: Float type; brass or cast iron body; copper, polypropylene, or solid non-metallic float; stainless steel valve and valve seat.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/4.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 240 deg F.

2.06 BUFFER TANKS:

- 1. Manufacturers:

- a. American Wheatley
 - b. Cemline Corporation
 - c. Wessels.
 - d. Niles Steel Tank.
2. Tank: Welded steel, rated for 125-psig working pressure. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- a. Provide integral air separator and connection.
 - b. Provide tank drain.
 - c. Tank Exterior: Red oxide primer.
3. Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure. Lifting lugs.

2.07 EXPANSION TANKS

- A. Bladder-Type Expansion Tanks:
- 1. Manufacturers:
 - a. American Wheatley
 - b. Amtrol Inc.
 - c. ITT Bell & Gossett.
 - d. Taco, Inc.
 - 2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; drain.
 - 3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 - 4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
 - 5. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and bypass valve.

2.08 AIR SEPARATORS

- A. Tangential-Type Air Separators:
- 1. Manufacturers:
 - a. American Wheatley
 - b. Armstrong International, Inc.
 - c. ITT Bell & Gossett.
 - d. Taco, Inc.
 - 2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature, labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; threaded blowdown connection.
 - 3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
 - 4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.

2.09 STRAINERS

- A. Y-Pattern Strainers:
- 1. Manufacturers:

- a. Armstrong International, Inc.
- b. Flexicraft Industries.
- c. Grinnell Mechanical Products.
- d. The Metraflex Company.
- 2. Body: ASTM A126, Class B, brass or cast iron with bolted cover and bottom drain connection.
- 3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
- 4. Strainer Screen: Stainless-steel:
 - a. NPS 2 and smaller: 1/32 inch NPS 2-1/2 DN 65 to NPS 4: 1/16 inch NPS 5 DN 125 and larger: 1/8 inch CWP Rating: 125 psig.
- B. Basket Strainers:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. Flexicraft Industries.
 - c. Grinnell Mechanical Products.
 - d. The Metraflex Company.
 - 2. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 - 3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 4. Strainer Screen: Stainless-steel:
 - a. NPS 3 and smaller: 1/16 inch NPS 4 DN 100 and larger: 1/8 inch
 - 5. CWP Rating: 125 psig.

2.10 PRESSURE-TEMPERATURE (PT) TEST PLUGS

- A. PT Test Plugs:
 - 1. Manufacturers:
 - a. Peterson Equipment Company Inc.
 - b. Ferguson Enterprises Inc.
 - c. Sisco Manufacturing Company Inc.
 - 2. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and EPDM rated for minimum 200 degrees F.
 - 3. Application: Use extended length plugs to clear insulated piping.

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

- A. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- B. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting. Provide vent tubing to nearest floor drain.
- C. Install piping from heat pump air outlet, air separator to expansion tank with a 2 percent upward slope toward tank.

- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks on the floor unless indicated otherwise on drawings. Vent and purge air from hydronic system and ensure that tank is properly charged with air to suit system Project requirements.
- F. Install strainers as indicated. Install NPS 3/4 nipple and ball valve in blow-down connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.

END OF SECTION

**SECTION 23 2123
HYDRONIC PUMPS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Separately coupled, base-mounted centrifugal pumps.
- B. Related Sections:
 - 1. Section 23 00 00 "HVAC General Requirements" for design conditions.
 - 2. Section 23 21 13 "Hydronic Piping".
 - 3. Section 23 21 16 "Hydronic Specialties".

1.03 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
 - 1. For systems with pumps in parallel: Provide performance curves noting single equipment operation and all iterations of additional equipment.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals. Include: installation instructions, assembly views, lubrication instructions, and replacement parts list.
- B. Extra Pump Seals: Provide one set for each pump type and size of pump.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- C. Each pump with motor in 5hp or larger shall be factory tested per Hydraulic Institute Standards prior to shipment.
- D. Pump selections with flat curves shall not be permitted.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anti-corrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location, on dunnage, and covered with a tarp or visqueen.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. MANUFACTURERS
 - 1. Grundfos.
 - 2. Armstrong.
 - 3. Bell & Gossett.
 - 4. Taco.
- B. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.02 SEPARATELY COUPLED, BASE-MOUNTED, CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, end-suction or double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
- B. Pump Construction:
 - 1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class 250 flanges. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
 - 2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 - 3. Pump Shaft: Stainless steel.
 - 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
 - 5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
- C. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. Provide EPDM coupling sleeve for variable-speed applications.
- D. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

- E. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36/A36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- F. Motor: Single speed, secured to mounting frame, with adjustable alignment.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - a. Enclosure: Totally enclosed, fan cooled.
 - b. Unusual Service conditions
 - 1) High Humidity
 - 2) Salt Air atmosphere

2.03 PUMP SPECIALTY FITTINGS

- A. Suction Diffusers and Triple Duty Valves are not to be used.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- F. Equipment Mounting:
 - 1. Comply with manufacturer’s recommendations and requirements for vibration isolation and seismic control devices specified in Section 23 05 48 “Vibration and Seismic Controls for HVAC.”
 - 2. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03 Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.
 - 4. Install in-line pumps on minimum 4 inch (100 mm) Schedule 40 steel post, or equivalent, bolted to concrete pad. Concrete pad.

3.03 ALIGNMENT

- A. Perform alignment service.

- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS

- A. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as pipe takeoffs to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- F. Install pressure gauges on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- G. Install check valve and shutoff valve on each condensate pump unit discharge.
- H. Ground equipment according to Division 26.
- I. Connect wiring according to Division 26.

3.05 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.

3.06 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

**SECTION 23 2300
REFRIGERANT PIPING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Refrigerant pipes and fittings.
 2. Refrigerant piping valves and specialties.
 3. Refrigerants.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
 1. Include pressure drop, based on manufacturer's test data, for the following:
 - a. Thermostatic expansion valves.
 - b. Solenoid valves.
 - c. Hot-gas bypass valves.
 - d. Filter dryers.
 - e. Strainers.
 - f. Pressure-regulating valves.
- B. Sustainable Design Submittals:
 1. Product Data for EA Prerequisite "Fundamental Refrigerant Management": For refrigerants, indicating compliance with refrigerant management practices.
- C. Shop Drawings:
 1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
 2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
 3. Show interface and spatial relationships between piping and equipment.
 4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- D. All copper refrigeration tube shall be marked with the metal or alloy designation, temper, size, and name of supplier
 - 1. Annealed Temper straight lengths or coils shall be identified with a tag indicating that the product was manufactured in accordance with ASTM B280
 - 2. Drawn-Temper straight length shall be identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
 - 3. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.07 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-134a:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
 - 2. Suction Lines for Heat-Pump Applications: 225 psig.
 - 3. Hot-Gas and Liquid Lines: 225 psig.
- B. Line Test Pressure for Refrigerant R-407C:
 - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
 - 2. Suction Lines for Heat-Pump Applications: 380 psig.
 - 3. Hot-Gas and Liquid Lines: 380 psig.
- C. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

2.02 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Mechanical Fittings: ETL tested and listed to UL 207 mechanical fittings for joining copper-to-copper. Fittings shall have dielectric coating. Fittings shall be certified to a working pressure of 600 psi. Fittings shall be wrapped with fusing non-adhesive silicone tape.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- G. Fitting Tape:
 - 1. Self-fusing, silicone tape. Silicone tape must withstand temperature ranges of -60 degrees Celsius to 260 degrees Celsius. Tape must have a tensile strength equal to or greater than 700psi and must be UL listed.
- H. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.

2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.03 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Flanged Unions:
 1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
 2. Gasket: Fiber asbestos free.
 3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
 4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
 5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 6. Pressure Rating: Factory test at minimum 400 psig.
 7. Maximum Operating Temperature: 330 deg F.
- F. Flexible Connectors:
 1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket.
 2. End Connections:
 - a. NPS 2 and Smaller: With threaded-end connections.
 - b. NPS 2-1/2 and Larger: With flanged-end connections.
 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 4. Pressure Rating: Factory test at minimum 500 psig.
 5. Maximum Operating Temperature: 250 deg F.

2.04 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 - d. Paul Mueller Company.
 2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 4. Operator: Rising stem and hand wheel.
 5. Seat: Nylon.
 6. End Connections: Socket, union, or flanged.
 7. Working Pressure Rating: 500 psig.
 8. Maximum Operating Temperature: 275 deg F.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Danfoss Inc.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 - e. Paul Mueller Company.
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 - d. Paul Mueller Company.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

D. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 - e. Paul Mueller Company.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 115-V ac coil.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

E. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 - d. Paul Mueller Company.
2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.

3. Piston, Closing Spring, and Seat Insert: Stainless steel.
 4. Seat: Polytetrafluoroethylene.
 5. End Connections: Threaded.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
- F. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Paul Mueller Company.
 2. Body, Bonnet, and Seal Cap: Forged brass or steel.
 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 4. Packing and Gaskets: Non-asbestos.
 5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 6. Suction Temperature: 40 deg F.
 7. Superheat: Adjustable.
 8. Reverse-flow option (for heat-pump applications).
 9. End Connections: Socket, flare, or threaded union.
 10. Working Pressure Rating: 700 psig.
- G. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 4. Packing and Gaskets: Non-asbestos.
 5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 6. Seat: Polytetrafluoroethylene.
 7. Equalizer: External.
 8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 115-V ac coil.
 9. End Connections: Socket.
 10. Set Pressure: 5 **psig**.
 11. Throttling Range: Maximum 5 psig.
 12. Working Pressure Rating: 500 psig.
 13. Maximum Operating Temperature: 240 deg F.
- H. Angle-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 2. Body: Forged brass or cast bronze.
 3. Drain Plug: Brass hex plug.
 4. Screen: 100-mesh monel.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 275 deg F.
- I. Moisture/Liquid Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 2. Body: Forged brass.
 3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 4. Indicator: Color coded to show moisture content in parts per million (ppm).
 5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 6. End Connections: Socket or flare.
 7. Working Pressure Rating: 500 psig.
 8. Maximum Operating Temperature: 240 deg F.
- J. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 4. Desiccant Media: Activated alumina.
 5. Designed for reverse flow (for heat-pump applications).
 6. End Connections: Socket.
 7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 8. Maximum Pressure Loss: 2 psig.
 9. Rated Flow: <Insert **tons**>.
 10. Working Pressure Rating: 500 psig.
 11. Maximum Operating Temperature: 240 deg F.
- K. Permanent Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 2. Body and Cover: Painted-steel shell.
 3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 4. Desiccant Media: Activated alumina.
 5. Designed for reverse flow (for heat-pump applications).
 6. End Connections: Socket.
 7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 8. Maximum Pressure Loss: **2 psig**.
 9. Working Pressure Rating: 500 psig.
 10. Maximum Operating Temperature: 240 deg F.
- L. Mufflers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - 2. Body: Welded steel with corrosion-resistant coating.
 - 3. End Connections: Socket or flare.
 - 4. Working Pressure Rating: 500 psig.
 - 5. Maximum Operating Temperature: 275 deg F.
- M. Receivers: Comply with AHRI 495.
- N.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Heldon Products; Henry Technologies.
 - 2. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - 3. Comply with UL 207; listed and labeled by an NRTL.
 - 4. Body: Welded steel with corrosion-resistant coating.
 - 5. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
 - 6. End Connections: Socket or threaded.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- O. Liquid Accumulators: Comply with AHRI 495.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Emerson Climate Technologies.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 - 2. Body: Welded steel with corrosion-resistant coating.
 - 3. End Connections: Socket or threaded.
 - 4. Working Pressure Rating: 500 psig.
 - 5. Maximum Operating Temperature: 275 deg F.

2.05 REFRIGERANTS

- A. ASHRAE 34, R-134a: Tetrafluoroethane.
- B. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
 - 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
 - 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-134a

- A. Suction Lines NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, Type L annealed-temper tubing and wrought-copper fittings with soldered joints.
- B. Suction Lines NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR, Type L light drawn-temper (H55) tubing and wrought-copper fittings with soldered joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
 - 1. NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR annealed-temper tubing and wrought-copper fittings with soldered joints.

2. NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR light drawn-temper (H55) tubing and wrought-copper fittings with soldered joints.
- D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with soldered joints.

3.02 PIPING APPLICATIONS FOR REFRIGERANT R-407C

- A. Suction Lines NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, Type L annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR light drawn-temper (H55) tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
 1. NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
 2. NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR, light drawn-temper (H55) tubing and wrought-copper fittings with brazed joints.
- D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.03 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
- B. Suction Lines NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR, light drawn-temper (H55) tubing and wrought-copper fittings with soldered joints.
- C. Hot-Gas and Liquid Lines:
 1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
 2. NPS 3/4 to NPS 2: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications NPS 2-1/2 to NPS 4: Schedule 40, black-steel and wrought-steel fittings with welded joints.
- E. Safety-Relief-Valve Discharge Piping:
 1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
 2. NPS 3/4 to NPS 2: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- F. Safety-Relief-Valve Discharge Piping NPS 2-1/2 to NPS 4: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.04 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.05 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.

- J. Refer to Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid conduit in locations where exposed to damage.
- O. Slope refrigerant piping as follows:
 1. Install horizontal hot-gas discharge piping with a uniform slope of 1/8-inch per foot away from the compressor.
 2. Install horizontal suction lines with a uniform slope of 1/8-inch per foot downward to compressor.
 3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- P. Install self-fusing silicone tape to completely enclose all mechanical fittings.
- Q. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- R. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 1. Shot blast the interior of piping.
 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.06 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill and continuously purge pipe and fittings with nitrogen, during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.07 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Utilize hangers that support the piping on the outside of the insulation with inserts, or hangers that incorporate a non-metallic insert.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

- E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2: Maximum span, 10 feet; minimum rod, 3/8 inch.
 2. NPS 2-1/2: Maximum span, 11 feet; minimum rod, 3/8 inch.
 3. NPS 3: Maximum span, 12 feet; minimum rod, 3/8 inch.
 4. NPS 4: Maximum span, 14 feet; minimum rod, 1/2 inch.
- F. Support multifloor vertical runs at least at each floor.

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

3.09 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 4. Charge system with a new filter-dryer core in charging line.
 5. When charging filter dryer shall be replaced after each three cylinders of refrigerant.
 6. Weigh refrigerant drum before charging and record in final charging report to enable accurate record of refrigerant charge.

3.10 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

F. END OF SECTION

**SECTION 23 2500
HVAC WATER TREATMENT**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes the following HVAC water-treatment systems:
 1. Manual and automatic chemical-feed equipment and controls.
 2. Stainless-steel pipes and fittings.
 3. Chemical treatment test equipment.
 4. Chemicals.
- B. Related Requirements:
 1. Section 23 05 13 "Common Motor Requirements for HVAC"
 2. Section 23 21 13 "Hydronic Piping"

1.03 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.04 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
 1. Bypass feeders.
 2. Chemical test equipment.
 3. Chemical material safety data sheets.
- B. Shop Drawings: Pretreatment and chemical treatment equipment identified above; showing tanks, maintenance space required, and piping connections to HVAC systems.
 1. Include plans, elevations, sections, and attachment details.
 2. Include diagrams for power and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For water filtration units and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- C. Field quality-control reports.
- D. Other Informational Submittals:
 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
 2. Water Analysis: Illustrate water quality available at Project site.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

PART 2 - PRODUCTS

2.01 VENDORS

- A. To match existing campus standard.

2.02 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems shall have the following water qualities:
 - 1. pH: Maintain a value within 9.0 to 10.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - 3. Boron: Maintain a value within 100 to 200 ppm.
 - 4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - 5. TSS: Maintain a maximum value of 10 ppm.
 - 6. Ammonia: Maintain a maximum value of 20 ppm.
 - 7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - 8. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
 - d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
 - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.03 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
 - 1. Capacity: 5 gal..
 - 2. Minimum Working Pressure: 125 psig.

2.04 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TSS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers; and oxidizing biocide test for open cooling systems.
- B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 - 1. Two-station rack for closed-loop systems.

2.05 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.01 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.02 INSTALLATION

- A. Install chemical application equipment on concrete bases level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. See Section 23 05 48 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install water-testing equipment on wall near water-chemical-application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water, and equipped with the following:
 1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 2. Install water meter in makeup-water supply.
 3. Install test-coupon assembly in bypass circuit around circulating pumps.
 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 5. Install a swing check on inlet after the isolation valve.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 23 21 13 "Hydronic Piping."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 23 05 23 "Valves for HVAC Piping,"
- E. See Division 22 for backflow preventers required in makeup-water connections to potable-water systems.
- F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26.
- H. Connect wiring according to Division 26.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC system's startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Comply with ASTM D3370 and with the following standards:
 - 1. Silica: ASTM D859.
 - 2. Steam System: ASTM D1066.
 - 3. Acidity and Alkalinity: ASTM D1067.
 - 4. Iron: ASTM D1068.
 - 5. Water Hardness: ASTM D1126.

3.05 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
 - 1. Initial water analysis and HVAC water-treatment recommendations.
 - 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 - 3. Periodic field service and consultation.
 - 4. Customer report charts and log sheets.
 - 5. Laboratory technical analysis.
 - 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

3.06 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION

**SECTION 23 3100
HVAC METAL DUCTS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - Ducts and fittings.
 - Sheet metal materials.
 - Flexible Ducts.
 - Duct liner.
 - Sealants and gaskets.
 - Hangers and supports.
 - Seismic-restraint devices.
 - Duct leakage testing.
- B. Related Sections:
 - Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - Section 23 07 13 "HVAC Duct Insulation".
 - Section 23 33 00 "Air Duct Accessories" for dampers, duct silencers, duct-mounting access doors and panels, turning vanes, and flexible connections.

1.03 PERFORMANCE REQUIREMENTS

- A. Duct system has been design for low friction drop, both through straight duct and through fittings. Fitting types or duct sizes may be substituted only for those of equal to or lesser pressure drop, with written permission from engineer of record. Maximum duct aspect ratio shall be 3:1 unless shown otherwise.
 - 1. Design pressure drop criteria:
 - 1) Supply, Return, Outside, and Transfer Air Ducts: maximum 0.10 in wg per 100 feet.
 - 2) Exhaust Air Ducts: maximum 0.08 in wg per 100 feet.
 - 2. Design velocity criteria:
 - 1) Ductwork within a mechanical room: maximum 1,800 feet per minute.
 - 2) Ductwork in a shaft: maximum 1,800 feet per minute.
 - 3) Indoor ductwork not within a mechanical room or shaft: maximum 1,200 feet per minute.
 - 4) Acoustical Consultant's recommendations, which supersede above criteria.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
Flexible ducts.
Liners and adhesives.
Sealants and gaskets.
Seismic-restraint devices.
- B. Shop Drawings:
Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
Factory- and shop-fabricated ducts and fittings.
Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
Elevation of top of ducts.
Dimensions of main duct runs from building grid lines.
Fittings.
Reinforcement details and spacing.
Seam and joint construction and sealing.
Penetrations through fire-rated and other partitions.
Equipment installation based on equipment being used on Project.
Locations for duct accessories, including dampers, turning vanes, flexible connectors, and access doors and panels.
Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.
Design Calculations: Calculations[, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation registered in the State of California] for selecting hangers and supports[and seismic restraints].

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. REGULATORY REQUIREMENTS
Construct ductwork to NFPA 90A standards.
- F. FIELD CONDITIONS
Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
Maintain temperatures within acceptable range during and after installation of duct sealants.

Ductwork shall be transported to the site in enclosed vehicles or with ends capped.
 Do not store ductwork directly on ground or floor.
 Ductwork stored or stacked on site shall be capped.
 Installed duct shall be capped at the end of the day with duct closure film. Duct found uncapped after the end of the day shall be cleaned.

1.07 COORDINATION

- A. Coordinate sizes and locations of concrete bases with casings and plenums. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.01 DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
- C. Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Slide on Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 2. Formed on Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

Manufacturers

 - 3. Ductmate Industries, Inc.
 - 4. Lockformer.
 - 5. Nexus Inc.
 - 6. Ward Industries

Transverse Joints in round ducts larger than 60 Inches in Diameter: Flanged.
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- F. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch thick or less, with more than 10 sq ft of non-braced panel area unless ducts are lined.

2.02 MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
Galvanized Coating Designation (except as noted below): G60 .
Galvanized Coating Designation for outside air intake ductwork, outdoor unjacketed ductwork, and as otherwise noted: G90 .
Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches .
- E. Duct Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during transportation and construction.
Product: DynAir Duct Protection Film or equivalent.
High tack water-based adhesive.
Thickness: 2 mils.
UV stability.
VOC content: zero.
Elongation before break: minimum 325%.

2.03 FLEXIBLE DUCTS

- A. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
Manufacturers:
 1. Casco L-181M.
 2. Flexmaster USA 1NI.
 3. Thermaflex MC.
 Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg negative.
Maximum Air Velocity: 4000 fpm .
Temperature Range: Minus 10 to plus 160 °F .
Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
NFPA 90A and NFPA 90B compliant.
- B. Acoustically Rated, Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; vapor-barrier film.
Manufacturers:
 1. Casco SF-181M.
 2. Flexmaster USA 1B.
 3. Thermaflex M-KE.
 Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
Maximum Air Velocity: 4000 fpm .
Temperature Range: Minus 20 to plus 175 deg °F .
Water Vapor Permeance: maximum 0.17 perms (ASTM E 96, Procedure A).
Insulation R-Value: R-4.2 minimum at 70 °F.
Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

NFPA 90A and NFPA 90B compliant.

- C. Flexible Duct Attachment:
Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches , to suit duct size.

2.04 DUCT LINER

- A. Refer to specification section 230713 "HVAC DUCT INSULATION"

2.05 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723 (ASTM E84); certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
Application Method: Brush on or spray on.
Solids Content: Minimum 65 percent.
Shore A Hardness: Minimum 20.
Water resistant.
Mold and mildew resistant.
Volatile Organic Content (VOC): Maximum 75 g/L (less water).
Maximum Static-Pressure Class: 10-inch wg , positive and negative.
Service: Indoor or outdoor.
Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Single-component, acid-curing, silicone, elastomeric. Comply with ASTM C 920, Type S, Grade NS, Class 25, Use O.
For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.06 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.07 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips. Basis of Design: Mason SCB.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of at least 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches .
- J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.

- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- L. Slope top of outdoor uninsulated rectangular ductwork to avoid pooling water.
- M. Under no circumstances will any labels be permitted on interior surfaces of ductwork. Any materials delivered to the jobsite with interior labels shall be physically and chemically cleaned to remove all remnants of the tag and/or adhesive used to place it.
- N. Where connecting flexible duct to metal duct the inner lining shall be placed a minimum of 6 inches over the metal. A zip tie shall be placed over the joint and the flexible duct collar attached with a minimum of three sheet metal screws with foil tape provided to seal the end. The duct insulation shall cover this assembly with the outer membrane covering the insulation and sealed with tape having an integral vapor barrier.
- O. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- P. Duct Tape is not permitted.
- Q. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- R. At exterior wall louvers, seal duct to louver frame. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Insulate unused portion of outside air intake or exhaust louvers, and duct to the insulated isolation damper. Blank-out material shall be same material as duct, painted black on exterior side. Install outside air intakes to pitch (1 inch per 20 feet) toward intake louver where possible, provide a low point drain prior to equipment where intake duct must slope down from louver. Seal ducts seams to form watertight joints.

3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- D. Repair or replace damaged sections and finished work that does not comply with these requirements. Comply with ASTM A780.

3.03 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Where practical, install concrete inserts before placing concrete. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 Do not use powder-actuated concrete fasteners for seismic restraints.

- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet .
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.
 Space lateral supports a maximum of 40 feet on center, and longitudinal supports a maximum of 80 feet on center.
 Brace a change of direction longer than 12 feet .
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors.
 Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling.
 Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 Set anchors to manufacturer's recommended torque, using a torque wrench.
 Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09.

3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
Test the following systems:
 - 1. Ducts with a Pressure Class of positive 3-Inch wg or higher or negative 3-Inch wg or lower: Test 100 percent of total installed duct area for each designated pressure class. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
Test for leaks before applying external insulation.
Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
Visually inspect duct system to ensure that no visible contaminants are present.
Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - 1. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.09 DUCT SCHEDULE

A. Fabricate ducts of galvanized steel except as otherwise indicated and as follows: Table: Duct Schedule

Type	Material	Pressure Class	Rect. Leakage Class	Round Leakage Class	Seal Class
Supply Risers/Mains	Galvanized	+ 4" w.g.	6	3	A
VAV Supply (before terminal boxes)	Galvanized	+ 3" w.g.	12	6	B
VAV Supply (after terminal boxes)	Galvanized	+ 2" w.g.	24	12	C
Return	Galvanized	- 2" w.g.	24	12	C
Transfer	Galvanized	- 1" w.g.	24	12	C
Outside Air	Galvanized	- 2" w.g.	24	12	C
General Exhaust	Galvanized	- 2" w.g.	12	6	B

B. Elbow Configuration:

Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

1. Velocity **1000 fpm** or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
2. Velocity 1000 to 1500 fpm :
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Velocity **1500 fpm** or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

4. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
5. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
6. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

7. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
8. Retain first three subparagraphs below, or delete and retain fourth subparagraph.
9. Velocity **1000 fpm** or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
10. Velocity **1000 to 1500 fpm**: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
11. Velocity **1500 fpm** or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
12. Radius-to Diameter Ratio: 1.5.
13. Round Elbows, **12 Inches** and Smaller in Diameter: Stamped or pleated.
14. Round Elbows, **14 Inches** and Larger in Diameter: Standing seam.

C. Branch Configuration:

Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

1. Rectangular Main to Rectangular Branch: 45-degree entry.
2. Rectangular Main to Round Branch: Spin in, conical entry.

END OF SECTION

**SECTION 23 3300
HVAC DUCT ACCESSORIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Backdraft dampers.
 2. Manual volume dampers.
 3. Fire dampers.
 4. Smoke dampers.
 5. Combination fire and smoke dampers.
 6. Duct silencers.
 7. Turning vanes.
 8. Remote damper operators.
 9. Duct-mounted access doors.
 10. Flexible connectors.
 11. Duct accessory hardware.
- B. Related Requirements:
 1. Division 07 for Firestopping.
 2. Section 23 31 00 "HVAC Metal Ducts" for flexible ducts.
 3. Division 26 for wiring connections.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

- B. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.07 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Duct Silencers:
 1. All tests shall be conducted by a laboratory that is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) to conduct the test. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Where test data is obtained in the manufacturer's laboratory, the facility shall be available for inspection and witnessed testing by the architect, mechanical engineer and acoustical consultant in order to verify compliance with the latest edition of ASTM Standard E477 or a test standard approved by the acoustical consultant. The architect or project acoustical consultant shall be the final arbiter in determining compliance.
 2. Manufacturer's Experience: The manufacturer shall have successful experience in duct silencer production, including no less than five years experience in fabrication and delivery of duct silencers equal in size and quantity to this work. The Manufacturer shall be capable of supplying references and acoustical test results for up to five recently completed projects similar to this work.
 3. Acoustical and Aerodynamic Performance: Duct silencer acoustical and aerodynamic performance shall be determined in accordance with the latest edition of ASTM Standard E477-90 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers or a test standard approved by the acoustical consultant. All silencer ratings shall be determined in a duct-to-reverberant room test facility that provides for airflow in both directions through the test silencer in accordance with the latest edition of ASTM E-477 test standard or a test standard approved by the acoustical consultant. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Provide duct accessories of materials suited to associated duct materials.

- D. Air extractors shall not be used, except with the expressed written consent of the Design Engineer.

2.02 BACKDRAFT DAMPERS

- A. General:
 - 1. Provide manufacturer's standard backdraft damper if available as fan or air-moving equipment accessory.
 - 2. Provide damper material of the same material as associated ductwork.
- B. Manufacturers:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff.
 - 3. Ruskin Company.
- C. Description: Gravity balanced.
 - 1. Maximum Air Velocity: 3000 fpm.
 - 2. Maximum System Pressure: match associated ductwork.
 - 3. Frame: Hat shaped, minimum 20 gage galvanized steel.
 - 4. Bearings: Synthetic.
 - 5. Blades: Multiple single-piece parallel blades, 28 gage galvanized steel.
 - 6. Blade Seals: Extruded vinyl, mechanically locked.
 - 7. Linkage concealed in frame.
 - 8. Blade Axles:
 - a. Up to 42 inch damper width: Nonmetallic or steel.
 - b. 42 inch width and larger: Steel.
 - 9. Tie Bars and Brackets: Galvanized steel.
 - a. Screen:
 - 1) Mounting: Front mounted in sleeve.
 - a) Sleeve Thickness: 20 gage minimum.
 - b) Sleeve Length: 6 inches minimum.
 - 2) Mounting: Rear mounted.
 - 3) Material: Galvanized steel.
 - 4) Type: Insect.

2.03 MANUAL VOLUME DAMPERS

- A. General Description: Factory fabricated, with required hardware and accessories.
- B. Manufacturers:
 - 1. Ruskin.
 - 2. Louvers & Dampers, Inc.
 - 3. Nailor Industries.
 - 4. Pottorff.
- C. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- D. Damper frame: Hat shaped, material shall match associated ductwork.
- E. Flanges for attaching to walls and flangeless frames for installing in ducts.
- F. Light Manual Volume Dampers:
 - 1. Frame: 3 inch deep, minimum 20 gauge galvanized steel.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Maximum Air Velocity: 1500 fpm.

5. Maximum System Pressure: 2 inch wg.
6. Axles:
 - a. 18 incheswide and below: minimum 3/8 inch square extended beyond frame with standoff bracket.
 - b. 19 incheswide and above: minimum 1/2 inch square extended beyond frame with standoff bracket.
7. Blades:
 - a. Stiffened, opposed-blade design.
 - b. 18 incheswide and below: 22 gage.
 - c. 19 incheswide and above: 16 gage.
 - d. Include locking hand quadrant to hold single-blade dampers in a fixed position without vibration.
8. Bearings: Molded synthetic.

2.04 CONTROL DAMPERS

- A. Commercial Grade Control Dampers:
 1. Manufacturers:
 - a. Tamco
 - b. Or equal
 2. Frames:
 - a. 16 gage galvanized steel hat channel reinforced with corner braces.
 3. Blades:
 - a. Multiple blade with maximum blade width of 8 inches.
 - b. Opposed-blade design.
 - c. 14 gage Galvanized-steel airfoil.
 - d. Blade Edging: neoprene, mechanically secured to blade.
 - e. Stainless steel jamb seals.
 4. Blade Axles: 1/2-inch- diameter; plated steel, operating temperature range from minus 25 to plus 250 deg F
 5. Bearings: Oil impregnated, self-lubricating, stainless steel sleeve.
 6. Linkage outside of airstream.
 7. Leakage Class 1. Testing according to AMCA Std. 500. Minimum ratings:
 - a. System pressure: 3.5 inch wg.
 - b. System velocity: 3,000 FPM.

2.05 FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 1. Ruskin Company.
 2. Louvers & Dampers, Inc.
 3. Nailor Industries, Inc.
 4. Ward Industries.
- B. General Requirements:
 1. Labeled according to UL 555C by an NRTL.
 2. Fabricate in accordance with NFPA 90A.
 3. Comply with construction details for tested assemblies as indicated in UL's "Fire Resistance Directory."
 4. Fire Rating: to suit wall, floor, ceiling, or corridor assembly, refer to Architectural Drawings.
 5. Operational ratings: suited to meet duct pressure and velocity design airflow conditions.
- C. Fire Dampers:
 1. Type: Dynamic.

2. Operational ratings: suited to meet design airflow conditions, and minimum 4-inch wg (1000 Pa) static pressure class and 2000-fpm (10 m/s) velocity.
3. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel; with mitered and interlocking corners.
4. Blades: Roll-formed, interlocking, airfoil, galvanized sheet steel.
5. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
6. Heat-Responsive Device: 165 deg F rated, fusible links.

D. Combination Fire and Smoke Dampers:

1. Operational ratings: suited to meet design airflow conditions, and minimum 4-inch wg static pressure class and 2000-fpm velocity.
2. Frame: galvanized sheet steel.
3. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
4. Smoke Detector: Integral, factory wired for single-point connection.
5. Blades: Roll-formed, one-piece airfoil, galvanized sheet steel.
6. Provide galvanized steel factory sleeve.
7. Actuator: electric, out of airstream, two-position, fail closed.
8. Leakage: Class I.
9. Damper test switch for cycle testing.
10. Auxiliary switch for fan signaling for fan shut down where failure of damper would block greater than than 50% of fan airflow.

2.06 DUCT SILENCERS

A. Manufacturers:

1. Vibro-Acoustics.
2. Ruskin.
3. Kinetics Noise Control.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.

C. Shape, material and connection Sizes: Match connecting ductwork unless otherwise indicated.

D. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

E. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.

F. Source Quality Control: Test according to ASTM E 477.

2.07 TURNING VANES

A. Manufacturers:

1. Duro Dyne Inc.
2. Ductmate Industries.

3. Metalaire.
 4. Ruskin.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Single Wall: 3/4 inch trailing edge and 2 inch radius.

2.08 REMOTE CABLE-DRIVEN VOLUME DAMPER OPERATORS

- A. Manufacturers:
1. Pottorff.
 2. Ventfabrics, Inc.
 3. Ventlok.
 4. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
1. Provide package for complete workable system for remote damper operation.
 2. Pressure Rating: 1 inch wg.
 3. Velocity Rating: 1,500 FPM.
 4. Tubing: Plastic.
 5. Cable: Stainless steel, 50 ft maximum length.
 6. Wall-Box Mounting:
 - a. Recessed, with tamper-proof, stainless steel cover plate.
 - b. Surface.

2.09 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall; insulation fill and thickness as indicated for duct pressure class, minimum 1 inch.
 - b. Hinges and Latches: continuous piano hinge and cam latches.
 - c. Shape and material to match ductwork.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - e. Doors shall open against air pressure.
 - f. On access doors on ducts of 4 inch wg pressure or greater, provide sign reading "CAUTION – DOOR CLOSES WITH AIR PRESSURE".
 2. Frame duct opening with continuous 1 inch by 1 inch angle. Provide sponge rubber or neoprene gasket at door-to-frame and frame-to-duct.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers:
1. Durodyne.
 2. Ventfabrics.
- B. Materials: Flame-retardant or noncombustible fabrics. NFPA 90A compliant.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..

2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Duct accessories shall match the material of the connecting or associated ductwork unless noted otherwise.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan and at outside air intakes as close as possible to the building exterior. Separate backdraft damper is not required where control damper is indicated, or otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
 1. Install volume dampers in each branch as far from the diffuser, register and grille as possible.
 2. Provide light volume dampers in ductwork rated 2 inch wg.
 4. Provide elevated dial or shaft extension for insulated ducts.
 5. Cut slot in end of volume damper rod (Quadrant End) to indicate blade position.
 6. Unless indicated otherwise below or on drawings volume dampers shall be standard design:
 - a. Spaces with sound rating NC 30 and below: Low Leakage
 7. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- E. Install cable-driven remote volume dampers for all volume dampers located in inaccessible ceilings or as indicated on Contract Drawings.
 1. Locate wall box within 10 feet in accessible location.
 2. Wall box shall be recessed-type in finished spaces.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers according to UL listing.
- I. Fire Damper installation is required for all ductwork penetrating fire-rated walls, floors, and ceilings. Smoke damper installation is required for all ductwork penetrating smoke-rated partitions. Coordinate location and rating of fire and smoke dampers with Architectural Drawings. Provide dampers where required even if not shown on Mechanical Drawings.
- J. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- K. Locate duct silencers a minimum of two equivalent duct diameters from elbows and fittings.

- L. Provide duct transitions from connecting ductwork to Duct Silencers as per Section 23 31 00 "HVAC Metal Ducts".
- M. Install turning vanes in all rectangular elbows.
 - 1. Ductwork up to 36 inch width: single wall vanes.
 - 2. Ductwork between 36 inch48 inchdouble wall vanes, 2 inch radius.
 - 3. Ductwork greater than48 inchdouble wall vanes, 4 inch radius.
 - 4. Acoustical turning vanes are not to be used unless specifically indicated on the Contract Drawings.
- N. Install duct silencers where shown on Drawings in accordance with the manufacturer's recommendations to obtain the published acoustical and air flow performance.
 - 1. Connect duct to silencer with rigid connection.
 - 2. Duct Silencer baffles should be oriented so as to be parallel to the plane of the turn if the silencer is located in a position less than three duct diameters in distance from the elbow. The duct diameter shall be based upon the maximum duct cross sectional dimension of the silencer.
 - 3. Do not locate rectangular silencers within one duct diameter of elbows, fan suction or discharge openings, takeoffs, etc.
 - 4. Support duct silencers independent of ductwork, provide seismic bracing.
- O. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. At outdoor-air intakes and mixed-air plenums.
 - 3. At drain pans and seals.
 - 4. Downstream from control dampers and equipment.
 - 5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 6. At each change in direction and at maximum 50-foot spacing.
 - 7. Upstream from turning vanes.
 - 8. Upstream or downstream from duct silencers.
 - 9. Control devices requiring inspection.
 - 10. Elsewhere as indicated.
- P. Install access doors with swing against duct static pressure.
- Q. Access Door Sizes:
 - 1. Rectangular duct larger than 30 inches: 24 by 24 inches.
 - 2. Rectangular duct up to 30 inches: 16 by 20 inches.
 - 3. Rectangular duct up to 18 inches: 12 by 12 inches.
 - 4. For ducts smaller than 18 inches: 2 inch12 inch
- R. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- S. Install duct test holes where required for testing and balancing purposes.
- T. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
 - 1. Allow at least 1 inch slack in flexible connections to insure that no vibration is transmitted from fan to ductwork.

2. Install flexible duct connections at all fan unit intakes, fan unit discharges, and as shown on drawings.
3. Where duct transition occurs from larger to small duct, flexible duct connection shall be sized and installed in the larger duct.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 3400**HVAC FANS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
 1. Inline centrifugal fans.
 2. Mixed Flow Fans
- B. Related Requirements:
 1. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.
 2. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 3. Section 23 07 13 – Duct Insulation.
 4. Section 23 33 00 – Air Duct Accessories: Backdraft dampers.
 5. Division 26 – Equipment Wiring: Electrical characteristics and wiring connections

1.02 REFERENCE STANDARDS

- A. ABMA STD. 9 – Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 2008).
- B. ABMA STD. 11 – Load Ratings and Fatigue Life for Roller Bearings; American Bearing Manufacturers Association, Inc.; 2014
- C. AMCA 99 – Standards Handbook; Air Movement and Control Association International, Inc.; 2010.
- D. AMCA 204 – Balance Quality and Vibration Levels for Fans.
- E. AMCA 210 – Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 2007 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- F. AMCA 300 – Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc.; 2008.
- G. AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 2007.
- H. NEMA MG 1 – Motors and Generators; National Electrical Manufacturers Association; 2011.
- I. SMACNA (DCS) – HVAC Duct Construction Standards; 2005.

1.03 ACTION SUBMITTALS

- A. See Division 01 – Administrative Requirements and Section 23 00 00 “HVAC General Requirements”, for submittal procedures.
- B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
 1. Fan operating efficiency.
 2. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 3. Material gages and finishes, including color charts.
 4. Dampers, including housings, linkages, and operators.
- C. System Data: For systems with multiple fans in parallel, provide fan curves with fans noted in a single fan curve.

- D. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
 - 1. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural supports.
 - 2. Roof openings.

1.05 CLOSEOUT SUBMITTALS

- A. Submit under provisions of General Conditions and Division 01 as applicable.
- B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- C. Manufacturer’s Installation Instructions.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.
 - 1. Extra Fan Belts: One set for each individual fan.
 - 2. Lubricant: One case of each type required.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. Certify sound-power level ratings according to AMCA 301, “Methods for Calculating Fan Sound Ratings from Laboratory Test Data.” Factory test fans according to AMCA 300, “Reverberant Room Method for Sound Testing of Fans.” Label fans with the AMCA-Certified Ratings Seal.
- D. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, “Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.” Label fans with the AMCA-Certified Ratings Seal.
- E. UL Standards: Fans shall comply with UL 705.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.09 FIELD CONDITIONS

- A. Permanent fans may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.
- B. Fans used during construction shall have all filters replaced when the Owner takes Ownership of the building.
- C. Lift and support units with manufacturer’s designated lifting or supporting points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Motors:
 - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
 - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 3. Speed Control: Fans shall be provided with Variable-frequency Drives (VFDs) or Electronically Commutated Motors (ECM) unless noted otherwise.
 - 4. Enclosure Type: Totally enclosed, fan cooled (TEFC) unless noted otherwise.
- D. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- E. Fabrication: Conform to AMCA 99. Fan construction class shall be sufficient to meet fan design air flow and pressure.
- F. Performance Base: Project elevation.
- G. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.02 MIXED-FLOW FANS

- A. Manufacturers:
 - 1. Loren Cook Company.
 - 2. Greenheck.
 - 3. New York Blower. Twin City.
- B. Description: Fan wheel and housing, factory-mounted motor with [belt] [or] [direct] drive and accessories.
- C. Construction:
 - 1. Housing: Steel with flanged inlet and outlet connections and bolted access doors and lifting lugs.
 - a. Mixed-flow Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.
 - 2. Mixed-flow Wheel Assemblies: Welded steel with curved single-thickness blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.
 - 3. Factory finish before assembly to manufacturer's standard.
- D. Bearings and Drives:
 - 1. Direct Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
 - 2. Belt Fan Drive: Factory mounted, with final alignment and belt adjustment made after installation.
 - a. Service Factor Based on Fan Motor Size: 1.5.
 - b. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
 - c. Fan Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.

3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 4. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
 5. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
 6. Motor Mount: Adjustable base. Provide threaded studs for positive belt tensioning.
 7. Shaft Bearings: Radial, self-aligning bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L10 of 40,000 hours.
 - b. Extend lubrication lines to outside of casing and terminate with grease fittings.
- E. Accessories:
1. Mounting Rails: welded to fan housing, of same material as housing.
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection factory-mounted outside fan housing, factory wired through an internal aluminum conduit.

2.03 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
1. Loren Cook Company.
 2. Greenheck.
 3. Penn Barry.
 4. Twin City.
- B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, belt- or direct-driven inline centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
- C. Construction:
1. Housing: Heavy gauge galvanized steel, inlet and outlet flanges, removable access panels, lifting lugs, and support bracket adaptable to floor, side wall, or ceiling mounting.
 2. Direct-Drive Units: Motor mounted in airstream.
 3. Fan Wheels: Aluminum, blades welded to aluminum hub.
- D. Accessories:
1. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in discharge; factory set to close when fan stops.
 2. Fan Guards: 1/2 by 1 inch (13 by 25 mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install centrifugal fans level and plumb.
- C. Support suspended units from structure. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- D. Install fan restraining snubbers; refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC." Adjust snubbers to prevent tension in flexible connectors when fan is operating.
- E. Install fans with resilient electrical leads; refer to Division 26.
- F. Provide sheaves required for final air balance.

- G. Provide backdraft dampers on discharge of exhaust fans and as indicated; refer to Section 23 33 00 "Air Duct Accessories".
- H. Install units with clearances for service and maintenance.
- I. Label fans according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Install flexible connections between fan inlet and discharge ductwork; refer to Section 23 33 00 "Air Duct Accessories". Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- B. Connect wiring according to Division 26.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. See Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

**SECTION 23 3470
COMMERCIAL CEILING FANS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Ceiling Fans
 - 2. High Volume Low Speed Ceiling Fans
 - 3. Related sections
 - 4. Division 11: Residential Ceiling Fans.
 - 5. Division 21 Fire Suppression
 - 6. Division 26 Electrical

1.02 REFERENCE STANDARDS

- A. ASCE 7 / 10 - Minimum Design Loads for Buildings and Other Structures.
- B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.
- C. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc; Including All Addenda (ANSI/ASHRAE/IES).
- D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. National Fire Protection Association (NFPA).
- F. Underwriters Laboratory (UL).

1.03 SUBMITTALS

- A. See Division 01 – Administrative Requirements and Section 23 00 00 “HVAC General Requirements”, for submittal procedures.
- B. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information.
- C. Sample materials and colors, if requested by the architect.
- D. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods.
- E. Product Documentation: The manufacturer shall furnish a copy of all installation, operation, and maintenance instructions for the fan.

F. QUALITY ASSURANCE

- G. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- H. Certifications:
 - 1. The fan assembly shall be built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
 - 2. The fan shall be compliant with NFPA 13—Standard for the Installation of Sprinkler Systems, NFPA 72— National Fire Alarm and Signaling Code, and NFPA 70—NEC.
 - 3. Controllers shall comply with NEC and UL standards and shall be labeled where required by code.

4. UL 1004-1. Standard for Safety for Rotating Electrical Machines - Part 1 General Requirements.
5. UL 1004-3. Standard for Safety for Thermally Protected Motors.
6. UL 1004-7. Standard for Safety for Electronically Protected Motors.

I. DELIVERY, STORAGE, AND HANDLING

- J. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
- K. The fan and its components must be stored in a safe, dry location until installation.
- L. Protect motors, shafts, blades, and bearings from weather and construction dust.
- M. Permanent fans may not be used during construction.

1.04 WARRANTY

- A. Provide manufacturer's standard warranty from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced by the manufacturer at no cost to Owner.
- B. Motors: 2 year.
- C. All other components: 1 year.
- D. All warranty service work shall be performed by a factory trained service professional.
- E. See Division 01 Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Big Ass Fans.
- B. MacroAir.
- C. Aeratron.

2.02 CEILING FANS

- A. Basis of design: Big Ass Fans Haikus (See floor plans for size)
- B. Motor
 1. The fan shall have an electronically commutated motor (ECM) rated for 100–240 VAC, single-phase.
 2. The fan shall be designed for continuous operation in ambient temperatures of 32–104°F (0–40°C), and a humidity range of 20–90% (non-condensing).
- C. Mounting System
 1. Universal Mount
 - a. The universal mount shall be suitable for flat or sloped ceilings with heights ranging from 8.5–18 ft.
 - b. The fan shall be equipped with a mounting bracket, canopy, mounting ball and wedge, extension tubes, wiring cover, motor hub, and mounting hardware.
 - c. Provide extension tube.
 - d. Confirm the exact size with floor plans and schedules
- D. Safety Cable

1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 1.5 mm in diameter and fabricated of aircraft steel.
2. Field construction of safety cables is not permitted.

E. Controls:

1. The fan shall be equipped with a compact IR remote control that allows intuitive operation of the fan in the following modes:
 - a. Off through High.
 - b. Sleep Mode
 - c. Timer Mode: In Timer Mode, the fan runs at a set speed until the programmed time period ends.
2. The remote shall control both the fan and light. Light brightness shall be increased or decreased by pressing the Up or Down Light button on the remote, and the light shall be turned on or off by pressing the Light On/Off button.

F. Accessories

1. An LED light may be selected at the time of order.

2.03 HIGH VOLUME, LOW SPEED FANS

A. Basis of design: Big Ass Fans Essence (See floor plans for size)

B. Complete Unit:

1. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 40 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
2. Airfoil System:
3. The fan shall be equipped with eight (8) upswept winglets designed to redirect outward airflow downward, thereby enhancing efficiency. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black.
4. As an option, the fan shall be equipped with eight (8) plug-style airfoil tips, molded of high strength polymer, in place of the eight (8) upswept winglets. The airfoil tips shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the airfoil tips shall be black.

C. Motor

1. The motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control.
2. The motor shall operate from any voltage ranging from 100–120 VAC or 200–240 VAC, single phase, and 60Hz, without requiring adapters or customer selection. The motor shall be a non-ventilated, heat sink design with the capability of continuous operation in -4°F to 131°F ambient condition.
3. The motor shall be rated IP43.

D. Mounting System

1. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent.
2. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.

- E. Hub
 - 1. The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.
- F. Safety Cable
 - 1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be Ø3/16" (0.5 cm) diameter and fabricated out of 7 x 19 stranded galvanized steel, pre-loaded and tested to 3,200 lbf.
 - 2. Guy Wires
 - a. Guy wires shall be included for installations with extension tubes 4 ft (or longer to limit the potential for lateral movement).
 - 3. Field construction of safety cables is not permitted.
- G. Wall Control
 - 1. Wired. The fan shall be equipped with a low-voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a rotary-style dial for controlling the fan's power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be by a standard, commercially available CAT5 (or higher) Ethernet cable that is field installed and provided by the installer.
 - 2. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to minimize starting and braking torques and shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system.
 - 3. Fire Control Panel Integration
 - a. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Ceiling fans:
 - 1. Coordinate exact location with drawings and Architect prior to installation.
 - 2. Install in accordance with manufacturer's instructions.
 - 3. The fan shall be installed by a factory-certified installer according to the manufacturer's instructions
 - 4. Install wall bracket for fan's remote controller in accordance with manufacturer's instructions.
- B. High volume low speed ceiling fans
 - 1. In areas equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
 - a. The HVLS fan shall be centered approximately between four adjacent sprinklers.
 - b. The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft.
 - c. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72—National Fire Alarm and Signaling Code.

3.02 CONNECTIONS

- A. Connect wiring according to Division 26.
- B. Connect guy wires and safety cable to the structure per manufacturer's recommendations

END OF SECTION

SECTION 23 3600
AIR TERMINAL UNITS

PART 1 - GENERAL**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
1. Shutoff, single-duct air terminal units.
 2. Series Fan Powered air terminal units
 3. Casing liner.
 4. Controls.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 3. Provide Sound Power Level Data: Units discharge and radiated at rated capacity. Sound power levels shall be at each octave band from 63Hz to 8000Hz. Sound data should comply with manufacturer sound power levels.
- B. Shop Drawings: For air terminal units.
1. Include plans, elevations, sections, and mounting details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
 4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension assembly members.
 2. Size and location of initial access modules for acoustic tile.
 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. Include the following:
1. Instructions for resetting minimum and maximum air volumes.
 2. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Price Industries.
 - 2. ENVIRO-TEC; by Johnson Controls, Inc.
 - 3. Titus.
 - 4. Or equal

2.03 SINGLE-DUCT AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: 0.034-inch- thick galvanized steel, single wall.
 - 1. Casing Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections, size matching inlet size.
 - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg.
- D. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

2.04 CONTROLS

- A. Direct Digital Controls: Single-package unitary controller specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
- B. Actuator and Velocity-Pressure Controller specified in Section 25 09 23.10 "Building Automation Sensors and Control Devices."
- C. Control devices shall be provided and factory-installed with the terminal units.
 - 1. Electronic Damper Actuator: 24 V, powered open, capacitous return.
 - 2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
 - 3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5

- percent of set point while compensating for inlet static-pressure variations up to 4 inch wg; and shall have a multipoint velocity sensor at air inlet.
4. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of airflow or temperature set points.
 - c. Adjusting and monitoring with portable terminal.
 5. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

2.05 CASING LINER

- A. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 1. Minimum Thickness: 1 inch.
 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. Adhesive shall have a VOC content of 80 g/L or less.
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.02 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7. Comply with requirements for seismic-restraint devices in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.03 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.04 CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Hot-Water Piping: Comply with requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Comply with requirements in Section 23 31 00 "HVAC Metal Ducts" for connecting ducts to air terminal units.
- D. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

3.05 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.06 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.07 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.08 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 23 3713.13

AIR DIFFUSERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Rectangular and square ceiling diffusers.
 2. Perforated diffusers.
 3. Linear bar diffusers.
- B. Related Requirements:
 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
 2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished, include NC level at design conditions in schedule.
- B. Samples: For each product color sample for review by Architect.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Ceiling suspension assembly members.
 2. Method of attaching hangers to building structure.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 SQUARE PLAQUE CONE CEILING DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Anemostat Products; a Mestek company.
 2. Krueger.
 3. Price Industries.
 4. Titus.
 5. Or Equal

- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Aluminum.
- D. Finish: Baked enamel, color selected by Architect.
- E. Face Size: Refer to project schedule.
- F. Face Style: Plaque.
- G. Mounting: Surface or T-bar, refer to project schedule.
- H. Pattern: Adjustable.
- I. Accessories:
 - 1. Equalizing grid.
 - 2. Sectorizing baffles.
 - 3. Extended beaded neck

2.02 PERFORATED DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Anemostat Products; a Mestek company.
 - 2. Krueger.
 - 3. Price Industries.
 - 4. Titus.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Steel backpan and pattern controllers, with aluminum face.
- D. Finish: Baked enamel, color selected by Architect.
- E. Face Size: Refer to project schedule.
- F. Duct Inlet: Round or Square.
- G. Face Style: Flush.
- H. Mounting: Surface or T-bar refer to project schedule..
- I. Pattern Controller: Adjustable with louvered pattern modules at inlet.
- J. Dampers: None.
- K. Accessories:
 - 1. Equalizing grid.
 - 2. Sectorizing baffles.

2.03 PERFORATED RETURN AIR DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Anemostat Products; a Mestek company.
 - 2. Krueger.
 - 3. Price Industries.
 - 4. Titus.
- B. Material: Steel backpan and pattern controllers, with aluminum face.
- C. Finish: Baked enamel, color selected by Architect.
- D. Face Size: Refer to project schedule.

- E. Duct Inlet: Round or Square.
- F. Face Style: Flush.
- G. Mounting: Surface or T-bar refer to project schedule..
- H. Pattern Controller: None.
- I. Dampers: None

2.04 ROUND UNDERFLOOR AIR-DISTRIBUTION DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Krantz.
 - 2. Price Industries.
 - 3. Titus.
 - 4. Trox.
- B. Airflow Principle: Swirl-pattern induction.
- C. Material: Plastic, high impact, and resistant to cart and foot traffic.
- D. Color: Gray.
- E. Components:
 - 1. Diffuser core.
 - 2. Flow regulator.
 - 3. Dirt and liquid catch pan.
 - 4. Spacer flange.
 - 5. Gasketed, underfloor compression ring.

2.05 WALL MOUNTED DISPLACEMENT DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Krantz.
 - 2. Price Industries.
 - 3. Titus.
 - 4. Trox.
- B. Performance:
 - 1. The diffuser manufacturer shall provide sound and pressure drop data derived from tests in accordance with ASHRAE 70.
 - 2. Performance data for Draft Rate (%DR) shall be provided based on tests in accordance with ASHRAE 55.
- C. Construction:
 - 1. The displacement flow recessed diffuser shall be constructed with an aluminum equalization baffle behind the perforated diffuser face for uniform, low velocity distribution of supply air. Both the equalization baffle and the face shall be securely retained in the diffuser frames.
 - 2. The diffuser shall be supplied with an installation frame for recessed installation.
 - 3. The diffuser frame shall be constructed of high strength aluminum for rigidity and protection of the perforated face and side panels. The perforated front panel shall be constructed of painted 18 gauge perforated steel, and the installation frame shall be 24 gauge steel.
 - 4. The diffuser shall not have visible fasteners on the front or side panels.
 - 5. The diffuser inlet shall be available for duct connection at the rear.
 - 6. Plastic nozzle arrays or any plastic components shall be unacceptable.

- D. Diffuser finish shall be :
 - 1. All steel components shall have custom color, to be specified by Architect, baked-on powder coat finish. Epoxies and their derivatives shall not be acceptable. Visible non-metallic components shall not be acceptable.
- E. The diffuser shall be installed within the supplied installation frame. The diffuser shall have no visible fasteners or framing, and shall be held within the supplied installation frame with secure mounting clips.
- F. Options:
 - 1. The diffuser shall be supplied with a mud frame for drywall applications.

2.06 LINEAR BAR DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Anemostat Products; a Mestek company.
 - 2. Krueger.
 - 3. Price Industries.
 - 4. Titus.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Aluminum.
- D. Finish: Baked enamel, color selected by Architect.
- E. Core: Refer to schedule
 - 1. Wide Core Spacing Arrangement: 3/16-inch- thick blades spaced 1/2 inch apart; zero-degree deflection.
- F. Frame: 1/2 inch wide.
- G. Mounting: Concealed bracket.
- H. Accessories:
 - 1. Two-Way Deflection Vanes: Extruded construction adjustable louvers with removable core.
 - 2. Alignment pins
 - 3. Core clips
 - 4. Blank-off strips.

2.07 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers level and plumb.

- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

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REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Adjustable blade face registers and grilles.
 2. Fixed face registers and grilles.
 3. Linear bar grilles.
- B. Related Requirements:
 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings, include NC level at design conditions in schedule.
 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished
- B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.
- C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Smallest size register and grille indicated.
- D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Smallest size register and grille indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Ceiling suspension assembly members.
 2. Method of attaching hangers to building structure.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 REGISTERS

- A. Adjustable Blade Face Register:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anemostat Products; a Mestek company.
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch (19 mm) apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch (19 mm) apart.
7. Frame: 1 inch (25 mm) wide.
8. Mounting Frame: Filter.
9. Mounting: Countersunk screw.
10. Damper Type: Adjustable opposed blade only where shown.
11. Accessories:
 - a. Rear-blade gang operator.

2.02 GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anemostat Products; a Mestek company.
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal; spaced 3/4 inch (19 mm) apart.
5. Face Arrangement: Perforated core.
6. Core Construction: Integral.
7. Frame: 1 inch (25 mm) wide.
8. Mounting Frame: Filter.
9. Damper Type: Adjustable opposed blade where shown
10. Mounting: Countersunk screw.

B. Linear Bar Grilles

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anemostat Products; a Mestek company.
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal; spaced 1/2 inch (13 mm) apart.
5. Face Arrangement: Perforated core.
6. Core Construction: Integral.
7. Distribution plenum.
 - a. Internal insulation.
 - b. Inlet damper.
8. Frame: 1 inch (25 mm) wide.

- 9. Mounting: Countersunk screw.

2.03 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 5216
HEAT PUMP HEATING HOT WATER

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 1 Specification Sections, apply to this section.

- A. Section 23 21 16 – Hydronic Piping Specialties.
- B. Section 23 21 23 – Hydronic Pumps.
- C. Section 23 25 00 – HVAC Water Treatment.
- D. Division 26 – Equipment Wiring: Electrical characteristics and wiring connections.

1.02 SUMMARY

- A. This section includes air source heat pump water heaters for potable water.

1.03 REFERENCES

- A. ASME (BPV IV) – Boiler and Pressure Vessel Code, Section IV – Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers Boiler and Pressure vessel code
- B.
- C. ISO 9001 Quality Management System
- D.
- E. NFPA 70- National Electric Code
- F.
- G. AHRI Directory of Certified Product Performance – Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
- H. ASHRAE Std. 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI/ASHRAE/IESNA Std. 90).

1.04 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties and accessories for each model indicated.
- B.

- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, components, and size of each field connection
- D.
- E. Wiring Diagrams: Detail for wiring power signal, differentiate between manufacture- installed and field-installed wiring
- F.
- G. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include maintenance guide and wiring diagrams

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for internal wiring of factory wired equipment
- B. Conform to ASME Section VIII for heat exchanger construction
- C.

1.06 QUALITY ASSURANCE

- A. Water heater shall have UL-1995 certification for the entire unit.

1.07 COORDINATION

- A. Coordinate size and location of concrete bases

1.08 WARRANTY

- A. Equipment shall include parts warranty for 12 months from startup or 18 months from shipment.
- B. Compressors shall include 5 year parts warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers:
 - 1. Mutistack
 - 2. Aermec
 - 3. Nyle
 - 4. Or equal

2.02 HEAT PUMP UNIT

- A. Heat pump water heater shall be packaged water source equipment, factory assembled, charged, and tested. The heat pump shall be suitable for heating water and have the capability of producing no less than 140°F, with published heating capacity and C.O.P. based on project specifications.
- B. Heat Pump unit shall consist of compressor, condenser, evaporator coil, hot water circulating pump, check valve, piping, and controls, factory assembled, charged, and tested.
- C. All components, including assemblies, sub-assemblies and the materials that go into constructing the heat pump water heater’s water system must be certified for coming in direct contact with potable water, including but not limited to: piping, brazing, soldering or welding materials, circulator pump, flow sensor, temperature sensors, thread sealant, flow control valves and flat plate heat exchanger.
- D. Entire heat pump shall be UL1995
- E. Electrical: Unit control panel shall be UL1995 & UL508A listed.

2.03 CABINET

- A. Shall be either corrosion resistant epoxy coated 12-gauge aluminum, 304L stainless steel or 316L stainless steel. Supports, channels and beams shall also be constructed of the like. Compartments shall have large access doors for servicing. Refrigerant components shall be in a separate compartment from fan for in-operation servicing. Unit shall have stainless steel drip pan for condensate. Cabinet shall be designed for outdoor operation. Cabinet shall be insulated to prevent condensation from forming on exterior surfaces.

2.04 COMPRESSOR

- A. Compressor: Each module shall contain two compressors hermetic scroll type by Copeland Corp., suitable for high temperature operation R-41A refrigerant. Compressor shall be furnished with service valves for suction and discharge connections. Compressors shall be on rubber-in-shear isolators.
- B. Compressor Controls: Compressor controls/accessories must include the following:
 - 1. High Pressure Safety monitoring
 - 2. Low Pressure Safety monitoring
 - 3. Multi-function Phase Failure Relay
 - 4. Active compressor mounted protection with advanced algorithms, fault history, and LED indicators.

2.05 CONDENSER

- A. 316 Stainless steel copper brazed plate vented double wall type, standard on all units; designed, tested and stamped in accordance with UL 1995 code for 650 psig working pressure. The load heat exchanger shall not be mounted above the compressor, to eliminate the effect of migration of refrigerant to the cold evaporator and consequent liquid slugging on startup. Refrigerant: Refrigerant shall be R-410A.
- B. Refrigerant Accessories:

1. Filter-Driers: Sweat connection type.
2. Site Glass: Moisture indicating type.
3. Liquid Line Service Valve: Bronze quarter turn type.
4. Discharge Check Valve: Copper magnetic in-line type.
5. Liquid Line Solenoid Valve: Electrically actuated.
6. Compressor Crankcase Heater: Belly band type
7. Suction accumulator
8. Liquid receiver

2.06 EVAPORATOR COIL

- A. Shall be aluminum fins with E-Coating for corrosion protection.
- B. Condensation shall be captured and drained to a single point connection with standard pipe threads

2.07 EXPANSION VALVE

- A. Thermal expansion valve shall be specifically designed for heat pump use with field adjustable superheat feature.

2.08 ANTI-SHORT CYCLE CONTROL

- A. Anti-Short Cycle Control: Units shall be factory wired to allow a maximum of twelve compressor starts per hour to prevent compressor short cycling and allow time for suction and discharge pressures to equalize permitting the compressor to start in an unloaded condition.

2.09 Controls:

- A. Scheduling of the various compressors shall be performed by a microprocessor based control system (Master Controller). A new lead compressor is selected every 24 hours to assure even distribution of compressor run time.
- B. The Master Controller shall monitor and report the following on each refrigeration system:
 1. Discharge Pressure Fault
 2. Suction Pressure Fault
 3. Compressor Winding Temperature
 4. Suction Temperature
 5. Load Water Leaving Temp.
- C. The Master Controller shall monitor and report the following system parameters:
 1. Load Water Entering and Leaving Temperature
 2. Discharge/Suction Refrigerant Temperature
 3. Load Water Flow

- D. An out of tolerance indication from these controls or sensors shall cause a “fault” indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire Heat Pump will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller’s LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).
- E. Individual monitoring of leaving Load water temperatures from each refrigeration system shall be programmed to protect against freeze-up.
- F. The Chiller shall be capable of interfacing to a building automation system. Interface shall be accomplished using an Interoperability Web Portal and shall be capable of communication over BACNet, (TCP/IP); Modbus, IP.
- G. Heat Pump shall have external inputs and outputs to be compatible with the building management system to include Remote Start/Stop capability and Cooling Alarm output.

2.10 CONSTANT LEAVING WATER TEMPERATURE CONTROL (SINGLE-PASS ONLY)

- A. Constant Leaving Water Temperature Control (Single-Pass only): Heat pump shall be factory equipped with electronic temperature control valve which automatically maintains constant leaving water temperature regardless of entering water temperature. Leaving water temperature is set by the heat pump operator/user via the field adjustable touch screen interface.

2.11 SINGLE POINT POWER CONNECTION

- A. Heat Pump shall be provided with a single point power connection at a **65,000 amp SCCR**. This will include pre-engineered wiring for field installation and connection to a factory mounted Heat Pump junction box. Junction box shall include individual fusing for each Module Set and provide a single point of connection to building power.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electric installations for unitary heat pumps to verify actual locations connections and electrical conduits before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Meet requirements of Division 01
 - 1. Provide support including false loading equipment for Commissioning function test to verify units’ supplemental heat for morning warm up / low temperature operation is functional.
- E. Subcontractor shall provide 48 hours advance notice of all inspections to the Construction Manager to witness inspection. Hold for inspection or witness.

3.02 INSTALLATION

- A. Equipment Mounting:

1. Install unitary heat pumps on concrete floor. Comply with requirements for equipment bases and foundations specified in Division 03.
2. Comply with requirements for vibration-isolation and seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

3.03 CONNECTIONS

- A. Drawings indicate general arrangement of pipework, fittings, and specialties. Specific connection requirements are as follows:
- B. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following field tests and inspections:
 1. After installing water to water heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Heat pumps will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.05 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Inspect for visible damage to unit casing.
 3. Inspect for visible damage to compressor and coils.
 4. Inspect internal insulation.
 5. Verify that labels are clearly visible.
 6. Verify that clearances have been provided for servicing.
 7. Verify that controls are connected and operable.
 8. Adjust vibration isolators.
 9. Start unit according to manufacturer's written instructions.
 10. Complete startup sheets and attach copy with Contractor's startup report.
 11. Inspect and record performance of interlocks and protective devices; verify sequences.
 12. Operate unit for an initial period as recommended or required by manufacturer.
 13. Verify thermostat calibration.
 14. Inspect controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.

3.06 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-source unitary heat pumps.

END OF SECTION

SECTION 23 7413
PACKAGED ROOFTOP AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The requirements of the General Conditions, Supplementary Conditions, And Division 1, General Requirements, apply to the Work of this section.

1.02 SUMMARY

- A. Section includes packaged rooftop air handling units with associated components and accessories.

- B. RELATED REQUIREMENTS

1. Division 22 – condensate drains.
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.
3. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
4. Section 23 07 19 – HVAC Piping Insulation.
5. Section 23 33 00 – Air Duct Accessories: Flexible duct connections.
6. Section 23 34 00 – HVAC Fans.
7. Section 23 82 16 – Air Coils.
8. Division 25 – Controls.
9. Division 26 – Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AFBMA 9 – Load Ratings and Fatigues Life for Ball Bearings
- B. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings
- C. AMCA 99 – Standards Handbook
- D. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes
- E. AMCA 300 – Test Code for Sound Rating Air Moving Devices
- F. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices
- G. AMCA 500 – Test Methods for Louver, Dampers, and Shutters
- H. AHRI 410 – Forced-Circulation Air-Cooling and Air-Heating Coils
- I. AHRI 430 – Central Station Air Handling Units
- J. AHRI 435 – Application of Central Station Air Handling Units
- K. NEMA MG1 – Motors and Generators
- L. NFPA 70 – National Electrical Code
- M. SMACNA – HVAC Duct Construction Standards – Metal and Flexible
- N. UL 900 – Test Performance of Air Filter Units
- O. VFD and options shall be ULTM 508 listed.
- P. NEMA 12 enclosed VFD shall be ULTM approved for mounting in conditioned air ducts and plenums.

- Q. The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA, National Electric Code NEC, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, and CE96.

1.04 ACTION SUBMITTALS

- A. Submit under provisions of General Conditions and Division 01 as applicable.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- C. Product Data:
1. Provide literature, which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, electrical characteristics and connection requirements.
 2. Provide data on filter media, filter performance data, filter assembly, and filter frames.
 3. Provide fan curves with specified operating point clearly plotted.
 4. Submit sound power level data for fan unit outlet, inlet and casing radiated at rated capacity and specified pressure.
 5. Submit electrical requirements for power supply including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.
 6. Submit performance and vibration test results of the fan for review prior to any air handling unit shipment to the jobsite.
- D. Controls Information:
1. Contractor shall review the control diagrams, sequences of operation, and points lists and confirm manufacturer's hardware and programming will allow:
 - a. Sequences of operation to be implemented without changes.
 - b. System integration via hardwired, BACnet, other platform communication.
 - c. Read / Write points integration.
 2. Contractor shall include a copy of the design control diagrams, sequences of operation, and points list as a part of their submittal and either sign off on agreeing to all aspects of the control intent or provide a letter to the same effect.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural members to which units will be attached.
 2. Roof openings.
 3. Roof curbs and flashing.
- B. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Seismic Qualification Certificates: For units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components, including fans, coils, and refrigeration components.

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Submit under provisions of General Conditions and Division 01 as applicable.
- B. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists and wiring diagrams.
- C. Manufacturer's Installation Instructions.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Extra Fan Belts: One set for each belt-driven fan.
 2. Filters: One set of filters for each unit.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience, which issues complete catalog data on total product.

1.09 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- C. Controls Coordination: Manufacturer shall review the controls design, including control diagrams, points lists, and written sequences of operation and confirm in writing on unit manufacturer corporate letterhead that manufacturer has:
 1. Reviewed the equipment sequence of operation and confirms that the factory supply sequence of operation can perform all aspects of the noted sequence.
 2. Reviewed the equipment points list and confirm that all points called for are provided and meet the read only or programmable status noted in the points list.
 3. Reviewed the equipment control diagram and confirms that the unit is configured as per the diagram.
 4. Noted any deviations from the control sequences, diagrams or points lists.

1.10 FIELD CONDITIONS

- A. Permanent fans may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.
- B. Fans used during construction shall have all filters replaced when the Owner takes Ownership of the building.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.11 Warranty

- A. See Division 01 – Closeout procedures, for additional warranty requirements.

- B. Provide manufacturer's warranty for period of 18 months from date of project substantial completion. Warranty to include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory-authorized on-site service.
 - 1. Warranty Period for Compressors Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Control Boards Parts: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Manufacturers:
 - 1. Basis of design by: Carrier
 - a. Deductive alternate by: Aeon
 - 2. Trane
 - 3. Daikin
- B. UL Compliance: Comply with UL 1995.
- C. AMCA Compliance:
 - 1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
 - 2. Damper leakage tested in accordance with AMCA 500-D.
 - 3. Operating Limits: Classify according to AMCA 99.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Unit shall be configured with economizer section, including associated relief/exhaust fan, outdoor, return and exhaust air dampers.

2.02 UNIT BASE

- 1. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, watertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.
- 2. All floor panels shall have a solid galvanized steel liner on the air stream side of the unit to protect the insulation during service and maintenance. Fans, coils and major components shall be supported with structural steel members.

2.03 UNIT HOUSING

- A. Constructed of galvanized steel (designated G90 per ASTM [American Society for Testing and Materials] Standard A653 — minimum coating weight of 0.9 oz of zinc per square foot), bonderized and primer-coated on both sides and coated with a baked polyester thermosetting powder coating finish on the outer surface.
- B. Unit casing shall be capable of withstanding ASTM Standard B117 500-hour salt spray test.
- C. Sides shall have person size insulated, double wall, hinged access doors for easy access to the control box and other areas requiring servicing. Each door shall seal against a rubber gasket to prevent air and water leakage.
- D. Interior cabinet surfaces (except heat exchanger section) shall be insulated with flexible fire-retardant dual-density (1.75-lb/cu ft) fiberglass blanket, coated on the air side. Insulation coating shall be cleanable and shall contain an EPA-registered immobilized antimicrobial agent to

effectively resist the growth of bacteria and fungi as proven by tests in accordance with ASTM Standards G21 and G22.

- E. Insulation shall be applied by means of adhesion using a water reducible adhesive sprayed onto interior surface. Adhesive shall maintain a satisfactory adhesion and cohesion within the temperature range of -20 to 180°F and have excellent resistance to water and water vapor when cured.
- F. Unit shall contain a sloped drain pan, to prevent standing water from accumulating. Pan shall be fabricated of stainless steel. Unit shall contain a factory-installed nonferrous main condensate drain connection.
- G. Units shall be equipped with lifting lugs to facilitate overhead rigging.
- H. Provide factory rain hoods at all outdoor air inlets. Provide birdscreen.

2.04 FANS

1. Supply Fan:

- a. Unit shall have only one fan wheel, scroll, and motor.
- b. Fan scroll, wheel, shaft, bearings, drive components and motor shall be mounted on a formed steel assembly which shall be isolated from the unit outer casing with factory-installed 2-in. deflection spring isolators and vibration-absorbent fan discharge seal.
- c. Fan shall be double-width, double-inlet, centrifugal belt driven forward-curve type with single outlet discharge (standard) or centrifugal belt driven airfoil blade section type with single outlet discharge (optional). Option airfoil fan shall include a high static pressure safety switch installed into the supply air plenum.
- d. Fan wheel shall be designed for continuous operation at the maximum rated fan speed and motor horsepower.
- e. Fan wheel and shaft shall be selected to operate at 25% below the first critical speed and shall be statically and dynamically balanced as an assembly.
- f. Fan shaft shall be solid steel, turned, ground and polished, and coated with rust preventative oil.
- g. Fan shaft bearings shall be self-aligning, pillow-block, regreasable ball or roller-type selected for a minimum average life of 200,000 hours at design operating conditions in accordance with ANSI B3.15.
- h. A single motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be mounted on a horizontal flat surface and shall not be supported by the fan or its structural members.
- i. Fan drive shall be constant-speed fixed-pitch. All drives shall be factory-mounted, with belts aligned and tensioned.

2. Condenser Fans:

- a. Direct-driven propeller type.
- b. Units shall have a direct driven, 11-blade airfoil cross section, reinforced polymer construction, and shrouded-axial type fans with inherent corrosion resistance.
- c. Low sound fans for outdoor sound reduction shall be available as a factory-installed option for all units (except 35 ton units).
- d. Discharge air vertically upward.

2.05 MOTORS

- A. Refer to Section 23 05 13 “Common Motor Requirements for HVAC Equipment”.
- B. Motors shall be driven by Variable-frequency Drives (VFDs) or Electronically Commutated (ECM). Refer to Section 23 05 14 “Variable-Frequency Drives for HVAC Equipment”.

2.06 COILS

- A. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- B. Fabrication:
 - 1. Type: Plate fin extended surface.
 - 2. Tubes: 5/8 inch OD seamless copper with 0.020 inch minimum final wall thickness, expanded into the fin collars to provide a permanent mechanical bond.
 - 3. Fins: minimum 0.008 inch thick aluminum or copper fins.
 - 4. Return bends: 0.025 inch wall thickness individually replaceable on both sides of the coil.
- C. Refrigerant Coils:
 - 1. Headers: Seamless copper tubes with silver brazed joints.
 - 2. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
 - 3. Configuration: Down feed with bottom suction.
 - 4. Expansion valve: Electronic expansion valve.

2.07 FILTERS

- A. Minimum arrestance and a minimum efficiency reporting value according to ASHRAE 52.2.
- B. Flat Panel Filter Housing: 2 inch , panel-type, MERV 13 air filters with holding frames.

2.08 DAMPERS

- A. Dampers shall be supplied with low leak extruded aluminum airfoil blades. Blades shall be supplied with rubber edge seals and stainless steel arc end seals. Rubber edge seals shall be backed by the damper blade to assure a positive seal in the closed position. Dampers shall be provided with nylon bearings within extruded openings.
- B. Damper leakage shall not exceed 6 CFM/ft² at 5.0” of static pressure. Leakage testing shall be in accordance with AMCA standard 500 figure 5.5. Test results must be from independent testing laboratory.

2.09 DX CONDENSING SECTIONS

- A. The Direct Expansion (DX) Condensing Section shall be fully integrated with the air handling unit.
- B. Refrigerant: R-410A.
- C. Compressors:
 - 1. Hermetic scroll type. One of the compressors shall be a digital scroll compressor providing step control.
 - 2. Each refrigeration circuit shall include all specialties for proper operation, including liquid line filter drier and sightglass, refrigerant distributor(s) with electronic expansion valve(s), and charging/service ports.

3. Pressure transducers shall be provide for the suction pressure and head pressure. Temperature sensors shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
4. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability.

D. Condensing Units:

1. Air Cooled Condensing Units shall incorporate a V-style coil arrangement to minimize the footprint and height of the unit. The entire condenser section shall be supported. Provide steel wire cooling guard.
2. Condenser coils shall be constructed of seamless copper tubing mechanically expanded into aluminum fins, and incorporate an integral subcooling circuit.
3. Condenser fans shall be direct drive, VFD controlled. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25-120F. Mechanical cooling shall be provided to 25F. The motor shall include thermal overlaod protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of loss of phase.

2.10 ELECTRICAL REQUIREMENTS

- A. Provide unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
- B. Provide duplex, 115 volt convenience outlet with 15 amp overcurrent protection.

2.11 CONTROLS

A. Basic Unit Controls:

1. Wall-mounted thermostat with the following features:
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.
 - d. Adjustable deadband.
 - e. **Exposed** set point.
 - f. **Exposed** indication.
 - g. Unoccupied-period-override push button.
 - h. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.
 - i. Changeover
2. Wall-mounted humidistat with the following features:
 - a. **Exposed** set point.
 - b. **Exposed** indication.
3. **Unit-Mounted Annunciator Panel for Each Unit:**
 - a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
 - b. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

B. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.

- b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
 - c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28.
 - d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
3. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum of **four** programmable periods per day.
 4. Unoccupied Period with separate heating and cooling setbacks and override function.
 5. Supply Fan Operation:
 - a. Occupied Periods: Run fan continuously.
 - b. Unoccupied Periods: Cycle fan to maintain setback temperature.
 6. Refrigerant Circuit Operation:
 - a. Occupied Periods: Cycle or stage compressors, to match compressor output to cooling load to maintain discharge temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
 - b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
 7. Fixed Minimum Outdoor-Air Damper Operation:
 - a. Occupied Periods: Open to minimum damper position as determined by TAB.
 - b. Unoccupied Periods: Close the outdoor-air damper.
 8. Economizer Outdoor-Air Damper Operation:
 - a. capacity. Controller shall permit air-side economizer operation. During economizer cycle operation, lock out cooling.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
 - c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 10 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature.
 9. Carbon Dioxide Sensor Operation:
 - a. Occupied Periods: Engage Demand Control Ventilation sequence to maintain Carbon Dioxide setpoint.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
 10. Terminal-Unit Relays:
 - a. Provide heating- and cooling-mode changeover relays compatible with terminal control system.
- C. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
 2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
 3. Provide BACnet compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
 - d. Monitoring occupied and unoccupied operations.
 - e. Monitoring constant and variable motor loads.
 - f. Monitoring variable speed controller operation.
 - g. Monitoring cooling load.
 - h. Monitoring economizer cycles.
 - i. Monitoring air-distribution static pressure and ventilation air volume.

2.12 ACCESSORIES

- A. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- B. Remote potentiometer to adjust minimum economizer damper position.
- C. Factory- or field-installed demand-controlled ventilation.
- D. Safeties:
 - 1. Smoke detector.
 - 2. Condensate overflow switch.
 - 3. High pressure control.
 - 4. **Electric coil** airflow-proving switch.
- E. Door switches to disable heating or reset setpoint when open.
- F. Outdoor air intake weather hood
- G. Service Lights and Switch: Factory installed in fan and coil sections with weatherproof cover.
- H. Roof Curb:
 - 1. Prefabricated mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling and condensing sections.
 - 2. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 3. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match unit, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish. All fans must be periodically rotated during storage period per manufacturer recommendation. Unit is to be alcohol wiped before shipment.

3.02 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of units.
- B. Examine roughing-in for units to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

- A. Equipment Mounting:
 - 1. Roof Curb: Install on roof structure or concrete base, level and secure. Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07. Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
 - 2. Install units level on structural **curbs steel supports**. Coordinate penetrations and flashing with construction. Secure units to structural support with anchor bolts.

3. Install units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.
4. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

- B. Install units with clearances for service and maintenance.
- C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.04 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain. Refer to Plumbing Drawings.
- B. Install piping adjacent to units to allow service and maintenance.
- C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 1. Install ducts to termination at top of roof curb.
 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 3. Connect supply ducts to units with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories."
 4. Install return-air duct continuously through roof structure.
- D. Power connections by Division 26.
 1. Connect convenience outlet to separate circuit as per NEC.

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. After installing units and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under observation.

3.07 INSTALLATION AND START UP

- A. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION

SECTION 23 8129

VARIABLE REFRIGERANT FLOW (VR) SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Variable refrigerant flow (VRF) system with heat recovery, consisting of:
 1. Outdoor/Condensing unit(s).
 2. Heat Pump Units.
 3. Indoor/Evaporator units.
 4. Refrigerant piping.
 5. Controls.

1.03 RELATED REQUIREMENTS

- A. Division 01 - Demonstration and Training, General Commissioning Requirements, Commissioning Authority Responsibilities.
- B. Section 23 21 13 – Hydronic Piping: Condensate drain piping.
- C. Section 23 08 00 - Commissioning of HVAC.
- D. Section 23 09 23 – Direct Digital Control (DDC) for HVAC
- E. Section 23 99 93 - Building Automation Sequences of Operations
- F. Section 26 05 19 – Low voltage Electrical Power Conductors and Cables.
- G. Section 26 27 26 – Wiring Devices: Power connections to equipment.

1.04 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.
- B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2011.
- C. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2009.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010 (ANSI/ASHRAE Std 15).
- E. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc; 2010, Including All Addenda (ANSI/ASHRAE/
- F. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; American Society of Mechanical Engineers; 2010.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 ACTION SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.
- C. Design Data:
 - 1. Provide design calculations showing that system will achieve performance specified.
 - 2. Provide design data required by ASHRAE 90.1.
- D. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
 - 1. Outdoor/Central Units:
 - a. Refrigerant Type and Size of Charge.
 - b. Cooling Capacity: BTU/h.
 - c. Heating Capacity: BTU/h.
 - d. Cooling Input Power: BTU/h.
 - e. Heating Input Power: BTU/h.
 - f. Operating Temperature Range, Cooling and Heating.
 - g. Fan speed control: Variable speed or number of discrete speeds (e.g. low, medium, high).
 - h. Air Flow: Cubic feet per minute.
 - i. Fan Curves.
 - j. External Static Pressure (ESP): Inches WG.
 - k. Sound Pressure Level: dB(A).
 - l. Electrical Data:
 - 1) Power Supply: Volts and Phase.
 - 2) Full Load Amps (FLA).
 - 3) Fan Motor: HP.
 - 4) Maximum Circuit Amps (MCA).
 - 5) Maximum Fuse Amps (MFA).
 - 6) Maximum Starting Current (MSC).
 - 7) Total Over Current Amps (TOCA).
 - m. Weight and Dimensions.
 - n. Maximum number of indoor units that can be served.
 - o. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
 - p. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
 - q. Control Options.
 - 2. Indoor/Evaporator Units:
 - a. Cooling Capacity: BTU/h.
 - b. Heating Capacity: BTU/h.
 - c. Cooling Input Power: BTU/h.
 - d. Heating Input Power: BTU/h.
 - e. Fan speed control: Variable speed or number of discrete speeds (e.g. low, medium, high).

- f. Air Flow: Cubic feet per minute.
- g. Fan Curves.
- h. External Static Pressure (ESP): Inches WG.
- i. Sound Pressure level: dB(A).
- j. Electrical Data:
 - 1) Power Supply: Volts and Phase.
 - 2) Full Load Amps (FLA).
 - 3) Fan Motor: HP.
 - 4) Maximum Circuit Amps (MCA).
 - 5) Maximum Fuse Amps (MFA).
 - 6) Maximum Starting Current (MSC).
 - 7) Total Over Current Amps (TOCA).
- k. Maximum Lift of Built-in Condensate Pump.
- l. Weight and Dimensions.
- m. Control Options.
 - 3. Shop Drawings: Schematic flow diagram showing fans, coils, dampers, outdoor units, indoor units, branch selector units and control devices.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
 - 5. Bill of Materials: A table, including quantities, of all equipment, controllers, and devices to be provided.
 - 6. Controls:
 - a. System architecture one-line diagram indicating schematic location of all controlled devices, controllers, gateways and interfaces.
 - b. Physical location of all user interfaces indicated on plans.
 - c. Physical location of all thermostats indicated on plans.
 - d. List of all available hardwired points, if any. Indicate where and at which device connection is made physically.
 - e. List of all available BACnet network points. Indicate where and at which device connection is made physically.
 - f. List of anticipated control zones, indicating setpoints and schedule to be programmed for each zone.
 - 7. Refrigerant Piping:
 - a. For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
 - b. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - c. Test Reports: Indicate results of leak test, acid test.

1.07 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Required working clearances and required area above and around units.
 - 2. Show layout and relationships between electrical components and adjacent structural and mechanical elements.
 - 3. Show support locations, type of support, and weight on each support.
 - 4. Indicate field measurements.
- B. Qualification Data: For testing agency.
- C. Seismic Qualification Certificates: For each unit, accessories, and components, from manufacturer.
 - 1. Certificate of compliance.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- D. Product Certificates: For each system from manufacturer.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Filter-Dryer Cartridges: One of each type and size.
- B. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.
- C. Extra Refrigerant: One container of refrigerant.

1.09 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.

1.10 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Manufacturer has been producing VRF heat pump systems for at least five (5) years.
 2. Manufacturer provides system design software to installers.
- B. Installer Qualifications: Factory-authorized installed trained and certified by manufacturer.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.
- B. Store equipment indoors.
- C. All duct and pipe segments shall remain capped and clean until ready for installation.

1.12 WARRANTY

- A. The entire VRF system shall be warranted by a single manufacturer or entity.
- B. Compressors
1. Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced by the manufacturer at no cost to Owner.
 2. Installing contractor shall furnish and submit additional tests and/or registration as required by the manufacturer to obtain the maximum available compressor warranty beyond the basic warranty period. Requirements vary by manufacturer. Contractor shall review and comply with manufacturer requirements for installed system.
- C. Motors: 1 years.
- D. All other components: 1 year.
- E. All warranty service work shall be performed by a factory trained service professional.
- F. See Division 01 Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design
 - 1. The system design shown in Contract Drawings is based on equipment and system designed by Toshiba-Carrier.
 - 2. The entire VRF system, excluding commodities such as wire and pipe, shall be provided by a single manufacturer and shall be warranted as a system.
- B. Systems designed and manufactured by other manufacturers will be considered by Engineer of Record under the terms described for substitutions with the following conditions:
 - 1. Substitutions: See –Division 01 “Product Requirements”.
 - 2. Substitution requests will be considered only if received at least 10 days prior to the bid date. Substitutions first proposed at submittal time will not be accepted.
 - 3. Substitution requests will be considered only if required submittal data is complete; see article SUBMITTALS above.
 - 4. Contractor (not equipment supplier) shall certify that the use of the substitute system and equipment will not require changes to other work or re-design by Architect.
 - 5. Contractor shall be wholly responsible for coordinating, documenting and implementing any VRF system design changes necessitated by the substitution.
 - a. Substitution shall not result in additional costs to the Owner.
 - b. Substitution shall not result in additional design time for the Engineer of Record.
 - c. Contractor shall provide shop drawings and as-built drawings in Revit or AutoCAD format.
 - 6. Contractor or HVAC subcontractor shall certify that the substitute system will achieve the performance specified.
 - 7. Do not assume substitution has been accepted until formal written notice has been issued by Architect.
 - 8. Proposed substitution heat pump system shall have published performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI Standard 1230 certified product directory

2.02 HVAC SYSTEM DESIGN

- A. General
 - 1. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
 - 2. See Contract Drawing mechanical schedules for performance requirements and design conditions.
 - 3. Zone Control
 - a. Provide a thermostat for every zone.
 - b. Provide capability for space temperature control for each individual indoor/evaporator unit independently of all other units.
 - c. Provide ability for each individual indoor/evaporator unit to select heating or cooling independently of all other units.
 - 4. The following information is provided on Contract Drawing mechanical plans:
 - a. Map of zones/conditioned spaces
 - b. Outdoor condenser unit locations
 - c. Indoor evaporator unit locations
 - d. Branch selector unit locations
 - e. Refrigerant piping location and sizes
 - f. Condensate piping (by others)

5. VRF system shall be capable of continuous operation when one or more indoor units are being serviced or power to indoor unit is disconnected. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable or allowed.
- B. Connection Ratio
1. The ratio of nominal indoor unit capacity to nominal outdoor unit capacity shall not exceed that implied by equipment selections listed in Contract Drawings mechanical schedule.
 2. Contractor is responsible for calculating the connection ratio based on scheduled equipment.
 3. In any case, connection ratio shall not exceed 150% without explicit permission from VRF system manufacturer.
- C. Setpoints shall be as indicated on Contract Drawing zone schedule or as follows:
1. Occupied Heating Setpoint: 68°F
 - a. Heating Setpoint Range: 65°F - 75°F
 2. Occupied Cooling Setpoint: 72°F
 - a. Cooling Setpoint Range: 70°F - 80°F
 3. Unoccupied Heating Setpoint: 60°F
 4. Unoccupied Cooling Setpoint: 85°F
 5. Heating and cooling setpoints shall be independently adjustable, as required by California Title 24.
 6. VRF control system shall prevent:
 - a. The heating setpoint from exceeding the cooling setpoint minus 2°F (i.e. the minimum difference between heating and cooling setpoints shall be 2°F)
 - b. The unoccupied heating setpoint from exceeding the occupied heating setpoint; and
 - c. The unoccupied cooling setpoint from being less than the occupied cooling setpoint.
- D. Outside Air Design Conditions: per mechanical schedule
- E. Operating Temperature Ranges:
1. Simultaneous Heating and Cooling Operating Range: minus 14°F to 60°F dry bulb.
 2. Cooling Mode Operating Range: 23°F to 110°F dry bulb.
 3. Heating Mode Operating Range: 0°F to 77°F dry bulb; minus 4°F to 60°F wet bulb
 4. Heating mode shall not require low ambient kit or auxiliary heat source.
- F. Wiring: Per manufacturer recommendations.
- G. VRF System Controls
1. System operation shall be controlled by a factory-installed microprocessor-based system controller which is integral to the VRF system.
 2. Install with hardwired control or network connections between outdoor unit(s) and indoor unit(s) so that entire VRF system is controlled as integrated whole. All features and functions of the entire VRF system, including indoor units, shall be available from the systems control panel.
 3. System shall provide time-based occupancy schedules and control overrides of indoor and outdoor units.
 4. System controller shall automatically perform ongoing self-diagnostics and shall notify users of faults and alarms via controls panel (below).
 5. Provide with connection for demand response load shed signal from utility.
 6. Provide the following control interfaces:
 - a. For each indoor/evaporator Unit: One wall-mounted wired local controller/thermostat, with temperature sensor; locate where indicated on Contract Drawings.
 - b. System controls panel, capable of controlling all indoor units and supporting all features listed in previous paragraph. Locate where indicated on Contract Drawings.

7. Native BACnet gateway, capable of communicating with a BACnet-based BAS system using native BACnet objects and protocol. Connection and mapping of gateway to BAS shall be by DDC Contractor. See Section 25 50 00.

H. Local Controllers/Thermostats

1. Thermostat/controller shall be wall-mounted, wired, containing temperature sensor in a ventilated cover.
2. Provide with insulated base.
3. There shall be three types of thermostats.
 - a. Type 1 – No Display, No Controls
 - 1) Blank cover
 - 2) No occupant controls
 - b. Type 2 – With Display, No Controls
 - 1) Cover shall include integral LCD display showing current temperature and active setpoint.
 - 2) No occupant controls.
 - c. Type 3 – With Display, With Controls
 - 1) Display per Type 2 thermostat.
 - 2) Include means for occupant to adjust setpoint (buttons, dials, or sliders).
 - 3) Include override pushbutton (“janitor’s button”) capable of being programmed to start system outside of scheduled occupancy.
 4. Unless otherwise called out on Contract Drawing mechanical floorplans or zone schedule, install thermostat Types based on location:
 - a. Open offices: Type 2
 - b. Private offices: Type 3
 - c. Corridors/hallways: Type 1
 - d. Conference/meeting rooms: Type 3
 - e. Classrooms, labs, multi-purpose rooms: Type 3
 - f. Lobbies, public spaces: Type 2
 - g. Equipment rooms and other back-of-house spaces: Type 2

I. Sequence of Operations

1. VRF system control shall be by control logic residing in the VRF system controller.
2. DDC BAS shall be connected to DDC BAS as shown on Contract Drawing control schematics.
3. VRF control system shall monitor and log all alarms and faults, and display them at the control interface.
4. VRF control system shall maintain 24/7 control schedule.
5. VRF control system shall operate VRF outdoor and indoor units as required to maintain temperature of each space between its currently active (i.e. occupied, or unoccupied) cooling setpoint and heating setpoint.

2.03 EQUIPMENT

- A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
 1. Refrigerant: R-410A.
 2. Performance Certification: AHRI Certified; www.ahrinet.org. EER and COP values shall be based on tests conducted at “full load” in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.
 3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL and bearing the certification label.

4. Provide units capable of serving the zones indicated.
 5. Thermal Performance: Provide heating and cooling capacity as indicated, based on operating conditions described in Paragraph 2.02E
 6. Energy Efficiency: Provide units with EER and/or COP equal or better to that listed in the Contract Drawing mechanical schedule.
 7. Outdoor Units: Units and their supports designed and installed to resist wind pressures defined in ASCE 7 for the Project location.
- B. Electrical Characteristics per Contract Drawing mechanical equipment schedule.
1. Provide factory-mounted disconnect switch.

2.04 REFRIGERANT PIPING

- A. Provide three-pipe refrigerant system.
- B. Provide pipe of material and type corresponding to manufacturer requirements, and length as required by system design.
- C. Provide hangers and supports that comply with MSS SP-58.
- D. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance.
- E. Refrigerant piping layout shall be designed so as to not require oil traps.
- F. Flexible Connectors:
1. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 2. Maximum Operating Temperature: 250 deg F (121 deg C).
 3. Offset Performance for vibration: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 4. Offset Performance for seismic: as required.
- G. Insulate each refrigerant line individually between the condensing and indoor units.
- H. Service valve shall be provided at each refrigerant piping connection to equipment (indoor units, outdoor units (each frame), and heat recovery units) to allow for servicing for VRF system without evacuating the entire piping system.

2.05 SOFTWARE

- A. Any software or smartphone apps associated with or required for the installation, testing, troubleshooting, maintenance, programming, operation or expansion of the VRF system shall be provided at no cost to the owner.
- B. If software is licensed on an annual basis, include the cost of at least five (5) years licensing with initial bid. In addition, clearly indicate on bid the requirement for and the cost of the annual license starting with the fifth year after installation.

2.06 OUTDOOR/CONDENSING UNITS

- A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with provided indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls.

1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
 2. Refrigerant: Factory charged.
 3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
 4. Capable of being installed with wiring to the left, right, rear or bottom.
 5. Capable of being installed with piping to the front or bottom.
 6. Modular design capable of being ganged for higher capacity.
 7. Heating:
 - a. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source.
 - b. Provide with low-ambient kit only if specified in Contract Drawing mechanical schedules.
 - c. Supplemental electric heat is not acceptable.
 8. Defrost and oil recovery operating mode shall not produce indoor space cooling. During mode operation, temporarily disable indoor unit fan, or continue to provide heating (e.g. with split coil).
 9. Sound Pressure Level Control: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 59 dB, 56 dB, and 53 dB, maximum or as shown on Contract Drawing mechanical schedule.
 10. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
 11. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
 12. Oil Recovery Cycle: as needed only based on oil level switch.
- B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
1. Designed to allow side-by-side installation with minimum spacing
- C. Fans:
1. Direct-drive propeller type fan with variable speed operation via variable frequency drive (VFD) or electronically commutated motor (ECM).
 2. Fan Airflow: Per Contract Drawing mechanical schedule
 3. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.
- D. Condenser Coils:

1. Copper or aluminum tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.
 2. Corrosion Protection: Fins coated with anti-corrosion resin and hydrophilic film or similar; pipe plates coated with powdered polyester powder coating or similar.
- E. Compressors: Scroll type, hermetically sealed, and variable speed inverter-driven;
1. Variable Speed Control
 - a. Capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure.
 - b. Compressor capacity control by changing inverter frequency.
 2. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost, or every 8 hours.
 3. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced system capacity manually or automatically; provide microprocessor and associated controls specifically designed to address this condition.
 4. Inverter Driven Compressors: PMV inverter driven, highly efficient reluctance DC (digitally commutating), hermetically sealed scroll.
 5. Rotors: Incorporating neodymium magnets for higher torque and efficiency.
 6. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
 7. Provide oil separators and intelligent oil management system.
 8. Compressor shall be isolated to avoid the transmission of vibration.

2.07 INDOOR/EVAPORATOR UNITS

- A. Contractor shall provide indoor units of quantity and type shown on Contract Drawings plans and schedules. Do not substitute unit types without written permission from Engineer of Record. Do not submit unit types which are not included in Project, even if listed in this Section.
- B. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
 1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
 2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
 3. Dehumidification/Drying Function: In conjunction with wall-mounted wired remote controller.
 4. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.

- a. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch.
- b. Sweat or flare connections to refrigerant piping.
- c. Provide thermistor on liquid and gas lines.
 5. Fans: Direct-drive, with statically and dynamically balanced impellers; minimum two speed (high and low) or continuously variable speed unless otherwise indicated; motor thermally protected.
 6. Supply Airflow Adjustment for ceiling cassette style units:
 - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
 - b. Field-modifiable to 3-way and 2-way airflow.
 - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
 7. Sound Pressure: No more than 32 dB(A) or as specified in mechanical schedule or noted below for specific unit types. Measured at low speed at 5 feet below unit.
 8. Return Air Filter: Washable long-life net filter with mildew proof resin and antifungal treatment, unless otherwise indicated. Filter shall be accessible from room (ceiling-mounted units only).
 9. Condensate Pan: Built-in mildew-proof condensate drain pan with connection. Include condensate safety shutoff and alarm.
 10. Condensate Pump: If gravity drainage of condensate is not feasible, include built-in or provide with condensate pump, with lift as required by application.
 11. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

C. Wall or Floor Surface-Mounted Units (Ductless)

1. White, finished casing, with removable front grille
2. Includes sound insulation
3. Provide with mounting brackets
4. Mildew-proof drain pan
5. Include built-in or provide with condensate pump, with lift as required by application.
6. Sound Pressure: No more than 43 dB(A) or as specified in mechanical schedule. Measured at low speed at 5 feet from unit.

D. Ducted Units

1. Ducted discharge and return; powder coated or galvanized steel cabinet.
2. Provide external static pressure switch adjustable for high efficiency filter operation
3. Mildew-proof drain pan

4. Include built-in or provide with condensate pump, with lift as required by application.
5. Where high efficiency filters are indicated on schedule, provide air filter rack.

2.08 EXTERNAL COIL CONTROL

A. Case/Enclosure

1. Powder coated sheet metal.
2. NEMA 4 for outdoor installation.
3. Hinged door or removable access panel, with weather seal.
4. Screw terminal block for control and power wiring connections.
5. Knockouts for wire and pipe routing.
6. Designed for mounting to air handler.

B. Controls

1. Provide controls and valve for modulation of refrigerant flow to an external heating/cooling coil.
2. Include the following sensors:
 - a. One return air temperature thermistor, shipped loose for field mounting at mixed return air side of AHU coil.
 - b. One evaporator coil pipe inlet temperature thermistor, shipped loose for field mounting between EEV kit and evaporator coil.
 - c. One evaporator coil pipe outlet temperature thermistor, shipped loose for field mounting.
3. VRF control system shall modulate refrigerant coil valve to maintain controlled variable at setpoint.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify General Contractor/Construction Manager and Engineer of Record if conditions for installation are unsatisfactory.

3.02 INSTALLATION

- A. Install equipment, controls, and refrigerant piping and specialties in accordance with equipment manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

- C. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install flexible connectors at compressors.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Insulate each refrigerant line and specialties individually between the condensing and indoor units with minimum 1" pipe insulation, or more if required by local code.
- F. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- G. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- H. Division 26 to provide separate power connections for each unit of equipment and wire factory-mounted disconnects.
- I. Coordinate with installers of systems and equipment connecting to this system.

3.03 FIELD QUALITY CONTROL

- A. Provide manufacturer's field representative to inspect installation prior to startup.
- B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.

3.04 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform system startup.
- B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- C. Adjust equipment for proper operation within manufacturer's published tolerances.
- D. Submit startup forms with Pre-Functional Test report.

3.05 CLEANING

- A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 COMMISSIONING

- A. See Division 01 for commissioning requirements.
- B. Perform commissioning as specified in Section 23 08 00.
- C. Perform Functional Tests as specified by Commissioning Authority and Commissioning Coordinator. At minimum, perform the following tests and provide Functional Test report for approval before closeout submittal.
 - 1. Override system clock to verify that system turns on and shuts off in accordance with programmed schedule and system clock.
 - 2. Override or manipulate (e.g. with hot air gun or compressed air can) zone temperature readings at each zone to verify appropriate heating or cooling response.
 - 3. Simultaneously override or manipulate temperatures in two zones on the same branch of the same outdoor unit so as to induce heating in one zone and cooling in the other, to verify that system can provide heating and cooling simultaneously.

3.07 CLOSEOUT ACTIVITIES

- A. See Division 01 - Closeout Submittals, for closeout submittals.
- B. See Division 01 - Demonstration and Training, for additional requirements.
- C. Provide Owner with System Manual including approved submittal, as-built mechanical and control drawings, as-built piping drawings, O&M's, troubleshooting guides, service manuals and engineering manuals in PDF format.
- D. Demonstrate proper operation of equipment to Owner's designated representative.
- E. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- F. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At project site.

3.08 PROTECTION

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

3.09 MAINTENANCE

- A. See Division 01 - for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 25 3000
BUILDING AUTOMATION SENSORS AND CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. This spec section is meant to be understood in conjunction with the other Division 25 specifications, control drawings, and
- B. The DDC Contractor shall furnish control devices, instruments, meters and sensors in accordance with this Section. Provide all control devices, instruments, meters and sensors required for a fully functional DDC System capable of fully executing the specified Sequences of Operations.

1.02 RELATED DOCUMENTS

- A. Related Specifications
 - 1. Division 1
 - 2. Division 23
 - 3. Division 25 – all other sections
 - 4. Division 26
 - 5. Division 27
 - 6. Division 28

1.03 CODES AND STANDARDS

- A. Workmanship, materials and equipment together with the resultant complete and operational DDC System shall be in compliance with the Authorities Having Jurisdiction (AHJ) for the project and the most restrictive of applicable local, state and federal codes and ordinances in cooperation with these plans and specifications.
- B. At a minimum, the installation shall comply with the applicable sections of the current editions in effect thirty (30) days prior to receipt of bids of the following codes:
 - 1. ANSI/ASHRAE Standard 135: Data Communication Protocol for Building Automation and Control Networks (BACnet)
 - 2. Building Industry Consulting Services International (BICSI): Telecommunications Distribution Methods Manual (TDMM)
 - 3. California Code Title 24, if Project is located in California
 - 4. International Building Code (IBC), for Projects outside of California
 - 5. International Mechanical Code (IMC), for Projects outside of California
 - 6. National Electric Code (NEC) with all state and local amendments

PART 2 - PRODUCTS

2.01 GENERAL

- A. It shall be the DDC Contractor's responsibility to ensure that all control devices are compatible with controller hardware, firmware, and software.
- B. All networked devices provided under this Section shall be native BACnet devices
- C. Provide signal conditioning for all instruments and sensors devices as recommended by device manufacturer and as required for proper operation in the system.
- D. Where signal conditioners, signal boosters, signal repeaters, or other devices are required for proper interface to controllers, DDC Contractor shall furnish and install proper device, including

120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

- E. Except as specifically noted in this Section, transmitters are assumed to be two-wire type with power supplied by the connected controller. If the controller is not compatible with two-wire transmitters, if the transmitter is to connect to more than one controller, or if length of wire to the controller would compromise accuracy, DDC contractor shall provide a four-wire transmitter and power supply as required.
- F. Products requiring an electrical connection shall be listed and classified by Underwriters Laboratories Inc. (UL), as suitable for the purpose specified and indicated.

2.02 ACTUATORS

A. General

- 1. At the AHU and central plant equipment, use of manufacturer specific actuator network to provide control intelligence is not acceptable. 0-10V and 4-20mA is the basis of design to execute the sequence for this project.
- 2. Use of manufacturer specific actuator network to daisy chain actuators or sensors as the only form of control is not acceptable for this project.
- 3. Actuator shall clearly indicate current position.
- 4. Use of floating point where an AO specified is not acceptable.
- 5. For fail-safe (fail-open or fail-closed) applications
 - a. Capacitor return is acceptable.
 - b. Electronic fail safe is acceptable for large valves where spring or capacitor return is not an available option from the manufacturer.
 - c. Use of battery pack to provide electronic spring return is not acceptable. Instances of powered safe return must be by emergency power provided by division 26. If no power by Div 26 is available, then the system is not deemed critical enough to warrant a batter pack.
 - d. All use cases for spring return to be submitted to EOR with implication for fail open and fail closed.
- 6. Mixing and matching valve and actuators from different manufactures is not acceptable as adapter kits are prone to failure or maintenance adjustments.
- 7. Analog position feedback signal from actuator output. The use of a separate potentiometer for position feedback is not acceptable.
- 8. Power Requirements
 - a. 120VAC actuators to be used for hydronic valves 6" and larger.
 - b. 240VAV actuators are acceptable for hydronic valves 6" and larger.
 - c. Design intent is for all valves greater than 24V to be concentrated in central plant and cooling tower yard as much as possible. Distributing valve power drops throughout the project would be an abuse of the coordinated work and will not be approved by EOR.
 - d. Damper actuators shall be 24V in all instances including AHU damper walls.

B. Modulating Actuators, All Types

- 1. Actuators shall accept a 0-10 VDC or 0-20 mA control signal and provide a 2-10 VDC or 4-20 mA operating range.
- 2. Any use of AO actuator shall have AI feedback for all instances.
- 3. Feedback shall be through actuator itself. Separate end switches are not acceptable.
- 4. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure.
- 5. Actuators shall have true proportional position control. Floating point actuators are not acceptable, except for terminal unit damper actuators which may be floating point type if both of the following conditions are met:
 - a. Actuator provides position feedback as an analog input to the terminal unit controller.

- b. Position end switches which recalibrate damper position feedback when end of stroke is reached. Recalibration shall be automatic and transparent to user.
 - 6. All modulating actuators shall have a built-in external switch to reverse direction of rotation.
- C. AHU Damper Actuators
 - 1. Actuator shall clamp directly to damper shaft. The clamp shall be all steel of a V-bolt design with associated V-shaped, toothed cradle for cold weld attachment.
 - 2. Single bolt or set screw type fasteners are not acceptable.
 - 3. Linking dampers to use fewer (but stronger) actuators often results in broken or slipped linkages or requires welding. Such application is not acceptable.
 - 4. For each individual damper section, the actuator shall be direct coupled to shaft, without connecting linkage.
 - 5. Twinning actuators to the same shaft to provide adequate torque is not acceptable. Use single actuator that provides enough torque.
 - 6. In the event that an actuator cannot supply enough torque at 24V, submit request to EOR for evaluation of using small or different damper or to use 120V power.
 - 7. Select actuator torque and/or quantity to satisfy all of the following requirements:
 - a. Sufficient to provide smooth proportional control with air velocities 20% greater than maximum design velocity.
 - b. As required by blade and/or edge seals, per damper manufacturer.
 - c. The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.
- D. For VAV or terminal unit applications using the DDC mfr integrated actuator is acceptable even if minor deviation from this specification occurs (example: manual crank, floating point).
- E. For VAV or terminal unit applications the torque requirement must be satisfied in all instances even if it means using separate high strength actuator. Particularly relevant for: non-standard, dual duct, large (16" and up), high flow, high pressure, laboratory fast response, terminal units such as underfloor systems, or retrofit boxes.
- F. Valve Actuators General
 - 1. Actuators shall be specifically designed for integral mounting to valves without external couplings.
 - 2. All central plant and AHU valves to have separate DDC controller input for feedback. Feedback to be integral to the actuator rather than separate end switch.
 - 3. Mixing and matching actuators to valves from different manufacturers is not acceptable.
 - 4. Actuators for 2-way valves shall have sufficient torque for
 - a. Tight closing against 150% of system pump shut-off head
 - b. Modulating duty against 150% of system pump shut-off head
 - 5. Actuators for 3-way valves shall have sufficient torque for tight closing against 150% of the full open differential pressure for which they are sized.

2.03 CONTROL VALVES

- A. General
 - 1. DDC Contractor shall provide type of valve per this specification, unless specifically indicated otherwise on Contract Drawings.
 - 2. Three-way valves are only to be used where specifically shown on Contract Drawings. Unless otherwise indicated, all control valves shall be two-way valves.
 - 3. Three way valves not to be used as the min flow bypass. In the even that there does not appear to be sufficient bypass, or a bypass with pressure relief valve, send RFI to EOR for clarification.
 - 4. Valve Size and Selection
 - 5. DDC Contractor is responsible for selecting valve C_v and size unless otherwise specified on Contract Drawings. Use the highest C_v that will provide good control, while observing the following limits:

6. C_v shall be greater than 1.0, to avoid clogging, unless protected by a strainer.
7. Valve size shall be as close as possible to pipe size while providing required C_v .

B. Ball Type

1. Application:

- a. Characterized ball valves are required for:
 - 1) All valves serving air side coils with analog control: AHU, FCU, and VAV.
 - 2) Heat exchangers
- b. Refer to SOO for other equipment that calls for analog control.
- c. Note: for radiant manifolds and use full port ball valves with no characterizing discs to provide minimum pressure drop and maximum flow.

2. Technical Attributes:

- a. Body: Nickel plated forged brass for all FCU and VAV terminal units. AHU and any other flanged valves shall be of same material of the pipe it connects to.
- b. Ball: Stainless steel
- c. Stem: Stainless steel
- d. Connection Type: threaded for all valves 2.5 inches and below. Flanged is acceptable above 2.5 inches.
- e. Pressure Rating: 150% of pump max PSI.
- f. Actuators of the same manufacturer with not coupling or retrofit kits.
- g. Weather Rating: valves in outdoor locations shall have NEMA 4 or NEMA 4x actuator. Weather shields are not an acceptable substitute. Indoor location NEMA 1 is acceptable.
- h. Power: 24V for all instances involving air side equipment coils. See central plant valves where higher power may be required for unique instances.
- i. Stroke Time: 150 sec
- j. Fail Safe: not required unless specifically called for in the sequence of operations. In the event that fail safe is necessary, spring return to be used in all instances where 24V is still an option. Valves larger than 4 inch may not offer spring return, then an electronic fail safe with capacitor or UPS battery must be used if emergency power is not available.
- k. Control Type: true AO, 0-10V or 4-20mA. Floating point is not acceptable.
- l. Feedback: Feedback shall be through actuator itself. Separate end switches are not acceptable.
- m. Sizing: DDC contractor responsible for sizing the valve with appropriate C_v for the flow conditions of the coil or equipment it serves.
- n. Manual Override: none required for FCU or VAV terminal units. Hand crank or keyed slot required for AHU for manual over-ride without removing the actuator.

3. Manufacturers

- a. Valve: Belimo, B200 series is basis of design for 2.5 inch and below, Belimo 6000 series is basis of design for 3 inch and above.
- b. Valve Actuator: basis of design is for the following series from Belimo: LR, LF, AR, AF, GR, GKR. TRF for terminal units only.
- c. Or equal, submit to EOR for written substitution approval

C. Butterfly Type

1. Application:

- a. Use for on/off control of hydronic equipment: boilers, chillers, cooling towers.
- b. Not acceptable for any terminal units.
- c. Not acceptable for radiant or change over valve applications.

2. Technical Attributes:

- a. Body: Epoxy-coated cast or ductile iron, full lug, extended neck
- b. Seat: Replaceable, non-collapsible, phenolic backed EPDM or PTFE
- c. Disc: Polished aluminum bronze or stainless steel with machined edge, mechanically locked to shaft. Sanded cast disc is not acceptable.
- d. Stem: stainless steel

- e. Pressure Rating: 150% of pump max PSI. Actuator must be sized to close against 150% of pump max psi.
 - f. Actuator Stroke Time: 150 sec
 - g. Actuators of the same manufacturer with not coupling or retrofit kits.
 - h. Weather Rating: valves in outdoor locations shall have NEMA 4 or NEMA 4x actuator. Weather shields are not an acceptable substitute. Indoor location NEMA 1 is acceptable.
 - i. Power: 24V for all instances 4" and below, 120V for all instances and above.
 - j. Power and conduit for valves above 24V to be provided by Div 26 as designed by DDC contractor.
 - k. DDC contractor to provide 120V or 240V transformer, BIM (as required by project documents) for Div 26 to execute.
 - l. Design intent is for all valves greater than 24V to be concentrated in central plant and cooling tower yard as much as possible. Distributing valve power drops throughout the project would be an abuse of the coordinated work and will not be approved by EOR.
 - m. Size of Valve: line size.
 - n. Use of double actuators on single valve to achieve torque rating is not acceptable.
 - o. Shut Off: bubble-tight shutoff at rated differential pressure
 - p. Manual Override: integral hand crank required
 - q. Control Type: true AO, 0-10V or 4-20mA if shown as AO on the control diagrams, floating point is not acceptable. Binary control is typically acceptable for isolation control, unless shown otherwise in the control diagrams. Anything other than binary control would typically indicate a unique sequence of operation.
 - r. Feedback: Feedback shall be through actuator itself. Separate end switches are not acceptable.
3. Manufacturers
- a. The following Belimo valve series are basis of design – F600, F6000
 - b. The following Belimo actuator series are basis of design – AR, AF, GR, , GKR, DR, DKR, PKR, SY
 - c. Bray
 - d. Or equal, submit to EOR for written substitution approval
- D. Globe Type
- 1. Not to be used. Globe valves are not acceptable for hydronic applications.
- E. Gate Type
- 1. Not to be used. Gate valves are not acceptable for any application.

2.04 WATER TEMPERATURE SENSORS

- A. Immersion Type
- 1. Application: Thermistor is acceptable for all applications with the exception being BTU meters. The BTU meter must use the BTU mfr thermistor or RTD.
 - 2. ¼" stainless steel probe, double encapsulated sensor, thermowell mounted, with enclosure suitable to location.
 - 3. Drift shall not exceed 0.3°F per year.
 - 4. Sensor shall not require recalibration for at least five years.
 - 5. Thermistor
 - a. Provide when required for compatibility with controller or to meet specified accuracy.
 - b. Output: resistive output to match DDC controller curve
 - c. Include zero and span adjustment
 - d. Accuracy: ±0.5F across sensor range
 - 6. RTD
 - a. Provide when required for compatibility with controller or to meet specified accuracy.
 - b. Output: 4-20mA linearly across specified temperature range

- c. Include zero and span adjustment
- d. Accuracy: $\pm 0.2F$ across sensor range
- 7. Provide with thermowell
 - a. One-piece machined brass or stainless steel
 - b. With lagging extension equal to pipe insulation thickness
 - c. Permits sensor removal from operating system
 - d. Rated for maximum system operating pressure, temperature and fluid velocity
- 8. Manufacturers
 - a. Belimo
 - b. Building Automation Products Inc.
 - c. Kele Associates
 - d. Mamac
 - e. Or equal
- 9. The use of direct immersion or strap-on type sensors is not acceptable.

2.05 WATER PRESSURE SENSORS

- A. General
 - 1. Two-wire transmitter, 4-20 mA output with zero and span adjustments
 - 2. Long-term stability 0.5% full scale per year
 - 3. Sensor shall be fixed-range. Switch-selectable pressure range is not acceptable.
 - 4. Pressure sensing range shall be as specified in points list. If range is not provided in points list, select sensor such that setpoint (or setpoint range, if reset) is between 25% and 75% of sensor full scale.
 - 5. Temperature range suitable for application
 - 6. Provide with valved “block and bleed” manifold allowing sensor to be isolated and vented. Vent ports shall be usable as test plugs for calibration.
- B. Water, Gage Pressure, General Purpose
 - 1. Device accuracy (at constant temp) $\pm 0.5\%$ full scale
 - 2. LCD display is required
 - 3. Range of pressure operation shall be minimum of 150% of max pump head.
 - 4. Manifold not required
 - 5. Output: 4-20mA only, 0-10 not acceptable.
 - 6. Manufacturers
 - a. Dwyer Series DPG-200
 - b. Or equal
- C. Water, Differential Pressure
 - 1. Application: all central plant instances
 - 2. Device accuracy (at constant temp) $\pm 0.1\%$ full scale
 - 3. LCD display is required
 - 4. Range of pressure operation shall be minimum of 150% of max pump head.
 - 5. Provide with 5-valve manifold
 - 6. Output: 4-20mA only, 0-10 not acceptable.
 - 7. Manufacturers
 - a. Setra 267 Series
 - b. Setra 231
 - c. Or equal

2.06 WATER FLOW METERS, HIGH ACCURACY

- A. General
 - 1. Flow sensor and signal converter shall be sold as a package by the same manufacturer.
 - 2. Install with isolation valves immediately upstream and downstream of meter. If isolation valves are by others, DDC Contractor shall coordinate installation with installing Trade. If hot-tapping an operating hydronic system, provide hot-tap isolation valve instead.

3. Install sensor in a location that provides sufficient lengths of straight pipe upstream and downstream of meter. Follow all manufacturer recommendations. If sufficient straight pipe is not available, notify Engineer of Record.
4. All I/O points shown as hardwired on Building Automation Drawings must be hardwired. Points shown as networked may be transmitted as BACnet objects via network, or as hardwired I/O points.
5. NSF Drinking Water approval for domestic water applications.

B. Magnetic, Insertion Type

1. Application: required for all central plant applications, closed and open loop.
2. Flow Sensor
 - a. Insertion electromagnetic flow sensor
 - b. Meter shall have at least two sets of electrodes, with the flow reading based on the average across all electrodes.
 - c. Stainless steel or Hastelloy C electrodes
 - d. No moving parts
3. Signal Converter/Transmitter
 - a. Adjustable zero and span
 - b. Hardwired I/O (where required, see control schematics): 0-10 V or 4-20 mA output for flow.
4. Performance
 - a. Flow velocity range: 0.3 - 20 FPS
 - b. Accuracy shall be $\pm 1\%$ of actual reading from .3 to 20 FPS flow velocity.
 - c. Accuracy shall be maintained over a turndown ratio of at least 10:1.
 - d. NIST traceable factory calibration performed on accredited water flow test rig.
5. Manufacturers
 - a. Onicon F-3500
 - b. Or equal

C. Ultrasonic, Inline

1. Application:
 - a. for central plant pipe diameters too small to accommodate insertion magnetic.
 - b. Also acceptable for use when feedback from this sensor is part of a non-revenue grade metering strategy rather than feedback to a PID loop.
2. Flow Sensor
 - a. Ultrasonic type measuring flow by differential transit time
 - b. Measurement by wetted direct-beam path. Clamp-on or indirect measurement is not acceptable.
 - c. Range suitable for application and design flows
 - d. Maximum 1.5 PSI pressure drop at design flow
 - e. Flanged connections for pipe over 2" diameter; threaded connections acceptable for 2" diameter or less.
 - f. All wetted parts shall be brass or stainless steel.
 - g. No moving parts
3. Signal Converter/Transmitter
 - a. Provide four-wire, externally powered transmitter with adjustable zero and span.
 - b. Hardwired I/O (if required): Flow signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow).
4. Performance:
 - a. $\pm 2\%$ of reading
5. Manufacturers
 - a. Onicon F-4600
 - b. Belimo Ultrasonic
 - c. Or equal

D. The following types of flow meter are not acceptable for high-accuracy applications:

1. Turbine meters
2. Clamp-on ultrasonic

2.07 WATER FLOW METERS, GENERAL APPLICATIONS

A. General

1. Application: general application water flow meters shall be used when:
 - a. Feedback from this sensor is part of a non-revenue grade metering strategy rather than feedback to a PID loop.
 - b. Where redundant flow meters are shown on control diagrams or sequence to provide backup to the primary flow meter.
2. Flow sensor and signal converter shall be sold as a package by the same manufacturer.
3. Install with isolation valves immediately upstream and downstream of meter. If isolation valves are by others, DDC Contractor shall coordinate installation with installing Trade. If hot-tapping an operating hydronic system, provide hot-tap isolation valve instead.
4. Install sensor in a location that provides sufficient lengths of straight pipe upstream and downstream of meter. Follow all manufacturer recommendations. If sufficient straight pipe is not available, notify Engineer of Record.
5. NSF Drinking Water approval for domestic water applications.

B. Turbine Type

1. Application: only when replacing an existing turbine type meter. This is not to be used for central plant applications.
2. Sensor Type:
 - a. For pipes 1" diameter and smaller: Inline turbine
 - b. For pipes 1.25" to 2" diameter: Single axial turbine.
 - c. For pipes 2.5" and larger diameter: Dual counter-rotating axial turbines. Each turbine element shall have its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion.
3. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
4. Include 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
5. Sensing method shall be impedance sensing (non-magnetic and non-photoelectric)
6. Volumetric accuracy
 - a. $\pm 2\%$ of reading
7. Analog outputs shall be 4-20mA
8. Manufacturers:
 - a. Onicon
 - 1) Single turbine: F-1100 Series
 - 2) Dual turbine: F-1200 Series
 - b. Or Equal

2.08 BTU METERS

A. General

1. Calculate BTU in software.

B. Application

1. Central plant hydronic systems.
2. External BTU meter with display is not required unless shown on control diagrams.
3. May be required as part of metering strategy

C. Features

1. Temperature sensors from the same mftr are required.
2. Temperature sensors must be a matched pair
3. LCD is required

4. BACnet or Modbus is optional, but the data required in the sequence of operations or metering strategy must be delivered. Therefore, totalization, cumulative quantities, rate conversions and/or any other data deliverables required may take place in either DDC controller or the BTU meter.
5. EOR is not dictating these networking sub-segments.

- D. Accuracy
 1. $\pm 1\%$ of reading
- E. Manufacturer
 1. Onicon
 2. Or Equal

2.09 WATER LEVEL SENSOR

- A. Ultrasonic Level Transmitter
 1. Application: water tanks (not drip pans).
 2. Continuous level transmitter shall produce an output signal that is proportional to level.
 3. Measurement shall be free from effects of changes in temperature, density, or acoustic noise in vapor space above level.
 4. Continuous measurement shall be independent of changes in material density and unaffected by presence of material clinging to sensing element.
 5. No moving parts and no routine cleaning and recalibration necessary.
- B. Float level sensor:
 1. Application: all cooling tower basins (as applicable)
 2. Provided by Div 23.
 3. Dry contact input to Div 25.
 4. Provide input to alarm for water level too low and contact to alarm for eminent overflow.

2.10 DAMPERS

- A. Refer to Division 23, provided by Div 23 contractor.

2.11 AIR TEMPERATURE SENSORS

- A. General
 1. Thermistor are acceptable for all instanced unless a specific application note calls for a high accuracy RTD.
 2. Must be suitable for temperatures being sensed
 3. Sensor shall not require recalibration for at least five years
 4. All outdoor sensors much have NEMA 4 enclosure if mounted external to ductwork.
- B. Thermistor
 1. Output: Must match the resistive input curve of the DDC controller.
 2. Include zero and span adjustment
 3. Accuracy: $\pm 0.5^\circ\text{F}$ across sensor range
- C. RTD
 1. Provide when required for compatibility with controller or to meet specified accuracy.
 2. Output: 4-20mA linearly across specified temperature range
 3. Include zero and span adjustment
 4. Accuracy: $\pm 0.2^\circ\text{F}$ across sensor range
- D. Duct Temperature Sensor, Single-Point Insertion
 1. Use in ducts not affected by temperature stratification.
 2. Probe shall be stainless steel.
 3. Provide with junction box for wiring connections and gasket to prevent air leakage and vibration noise.

4. Minimum insertion length of 20% of duct width
- E. Duct Temperature Sensor, Averaging
 1. Application:
 - a. When shown on Building Automation Drawings
 - b. Air handler mixing plenums
 - c. Ductwork of 36ft² or larger cross-sectional area, or more than 6 ft in height or width.
 2. Accuracy: $\pm 0.5^{\circ}\text{F}$ across sensor range
 3. Sensor length shall be at least 1 linear foot for each 2 ft² of duct area.
 4. Probe shall be flexible aluminum or copper.
 5. Provide with junction box for wiring connections and gasket to prevent air leakage and vibration noise.
 6. Accuracy:
- F. Outdoor Air Temperature Sensor
 1. Encapsulated or wall-mount temperature sensor installed in aspirated enclosure
 2. Using standard duct temp in OSA intake of AHU is preferred, only when multiple AHU OSA temps are averaged to create a virtual point for the whole bldg.
- G. Manufacturers
 1. Belimo
 2. Building Automation Products Inc
 3. Kele Associates
 4. Mamac
 5. Or equal

2.12 THERMOSTATS, DIRECT DIGITAL

- A. General
 1. Every thermostat must have an LCD display.
 2. Covers for thermostats may be required in as part of the owner requirement documents.
 3. Every thermostat must have input for control. However, see the sequence of operations to see how these are to be used. There may be averaging or switch over logic to prevent issues arising from conflicting inputs.
 4. Every thermostat to include override input
 5. Thermostat shall consist of a sensing element within a ventilated cover.
 6. Provide with insulated base and wall box.
 7. For thermostats connected to terminal box controller that requires calibration, include port for connection of POT or laptop.
- B. Communication
 1. Building Automation Drawings may show hardwired point connections but thermostat may connect to BAS via any of the following methods:
 - a. Hardwired points (4-20 mA or 0-10 V)
 - b. When used as an averaging point, or part of a large space array, these may be a BACnet networked device, but at least one temp sensor must be hardwired.
 - c. A proprietary connection between thermostat and controller is acceptable if and only if all thermostat data is available as objects from the terminal unit controller.
 2. Thermostat may use wireless communication with the following restrictions
 - a. Each thermostat shall communicate directly with the device that it controls, without intermediate device. Mesh-network communication is not acceptable without approval from Engineer of Record.
 - 1) Deviations from this requirement will be considered with appropriate submittals. If deviation is sought, **provide pre-submittal** with complete information on proposed device. Wireless devices submitted for the first time with Submittal Package 1 will be rejected.

- b. DDC Contractor assumes full responsibility for the reliable and robust performance of wireless communication. If wireless connection is deemed unreliable by Engineer of Record, Commissioning Authority, or Owner, DDC Contractor shall be responsible for replacing wireless thermostats with wired equivalents at no cost to the Owner.

C. Thermostat Features

- 1. Refer to sequence of operations for selection by equipment.
- 2. Occupancy with built in PIR sensor is only acceptable in small offices with occupancy up to 2.
- 3. Occupancy detection for all other instances shall be through ceiling mounted occupancy sensor with hardwire input into terminal unit controller.
- 4. Unless sequence, network architecture or other explicit instructions requiring integration are given, integration should not be used.
- 5. Window contacts for manually or automated windows is required per Title 24 2019. Thermostats with IO may link these in with occupancy sensors.

D. Accuracy

- 1. +/- 3%

E. Manufacturers

- 1. Matching manufacturer of DDC controller it is connected to for all terminal units.
- 2. Exceptions:
 - a. Unique instances where 3rd party temp sensors are used include WiFi, Bluetooth, 900MHz, BACnet communicating, or if special provisions for thermostat with IO are clearly indicated in the contract documents.
- 3. No substitutions

2.13 HIGH/LOW STATIC PRESSURE SWITCH

A. General

- 1. Application: to be used as a safety switch that prevents excessively positive/negative conditions in duct work.
- 2. Notable applications include immediately at the exit of a supply fan or entrance to a return fan.
- 3. Unlike most IO sensors in this spec, this device should require no power and be hardwired directly to the kill input of a fan.
- 4. Manual reset is mandatory for these safety devices.

B. **Manufacturers:**

- 1. Basis of design - Dwyer - 1831-1-RA-S
- 2. Or equal.

C. **Technical Attributes:**

- 1. Power: none required. This should operate if the controls are powered off and the fan is in hand.
- 2. Range: 2" w.c. to 9" w.c.
- 3. Temp Conditions: -10F – 150F
- 4. Output: manual reset, DPDT

2.14 FILTER PRESSURE SWITCH

A. General

- 1. Application: to be used for small supply fans with filters that are not part of any AHU, Pkg AC, ERV.
- 2. This device could be used on FCU filters, especially when 3rd party filter cabinets are added, however VRF OEM filter pressure sensors are preferred.
- 3. The presence of this section does not eliminate other possibilities for sensing filter differential pressure such as pressure switches to BACnet status devices, integrating to OEM controls, etc.

B. **Manufacturers:**

1. Belimo – 01APS-50R
2. Dwyer - ADPS/EDPS
3. Or equal.

C. Technical Attributes:

1. LCD: optional not required.
2. Range: 0-1" w.c. +/- 20%
3. Temp Conditions: 20F – 115F
4. Output: Binary output, 0-10V
5. Settings: Automatic reset and field adjustable setpoints and switching hysteresis.
6. Accuracy: +/- 5%
7. Enclosure: indoor, in duct, or in panel locations use NEMA 1 will suffice, outdoor locations NEMA 4

2.15 BACNET FILTER DIFFERENTIAL PRESSURE SENSOR

A. General

1. Application: to be used for small supply fans with filters that are not part of any AHU, Pkg AC, ERV.
2. The presence of this section does not eliminate other possibilities for sensing filter differential pressure such as pressure switches to BACnet status devices, integrating to OEM controls, etc. This section exists to provide a cost effective pathway for status where other sources of IO are unavailable AND where differential pressure is part of a PID loop.

B. Manufacturers:

1. Dwyer – MS2 series
2. Bravo Controls – 1" w.c. series
3. Or equal.

C. Technical Attributes:

1. LCD: optional not required.
2. Range: 0-1" w.c. +/- 20%
3. Output: Analog outputs, 0-10V or 4-20ma
4. Communication: BACnet MS/TP
5. Accuracy: +/- 5%
6. Enclosure: indoor, in duct, or in panel locations use NEMA 1 will suffice, outdoor locations NEMA 4

2.16 AIR PRESSURE SENSORS

A. General

1. Sensor: Differential capacitance cell, with temperature compensation
2. Transmitter: Loop powered, two-wire 4-20 mA output with zero adjustment
3. Pressure span shall be as specified in points list. If span is not provided in points list, select sensor such that setpoint (or setpoint range, if reset) is between 25% and 75% of sensor full scale.
4. Provide with static pressure pickup tip/port with flexible tubing.
5. Provide with plastic housing suitable for surface mounting.

B. Differential Sensor, General

1. Application: all AHUs and any application with pressures over ±0.5 inches.
2. Sensor range may be switch-selectable. Set sensor range.
3. Accuracy shall be no less than ±1% of full scale selected for application (not ±1% of sensor maximum scale).
4. Provide with LCD display in all instances

C. Differential Sensor, High Accuracy

1. Application: fixed range for low pressure/high precision applications for any of the following applications:
 - a. Building pressure monitoring or control
 - b. Underfloor air distribution plenum pressure
 2. Provide fixed-range sensor. Switch-selectable range is not acceptable for this application. Select sensor range
 3. Accuracy shall be no less than $\pm 0.25\%$ of full scale.
 4. Provide with LCD display in all instances.
- D. Manufacturer / Application:
1. Duct or filter pressure: Pitot tip, Dwyer A-302 or equal
 2. Plenum pressure: Straight tip with surge damper, Dwyer A-421 or equal
 3. Space pressure: Flush-mount wall plate with screened port, Dwyer A-417 or A-465, or equal
 4. Building pressure: Outdoor pickup port shielded to minimize effects of wind gusts, Dwyer A-306 or A-420, or equal
- E. Manufacturers
1. Air Monitor
 2. Dwyer
 3. Modus
 4. Paragon
 5. Setra
 6. Or equal

2.17 AIRFLOW MEASUREMENT STATIONS – Thermal Dispersion

- A. General
1. AFMS shall consist of an air velocity sensor assembly and associated controller/transducer.
 2. Air velocity sensor nodes shall be thermal dispersion type. Differential pressure is not acceptable. See Sensor Assembly below for additional requirements.
- B. Application: AHU
- C. Performance
1. The installed total accuracy for airflow shall be better than $\pm 3\%$ of reading over the sensor probe operating ranges when installed in accordance with manufacturers' guidelines.
 2. Installed accuracy shall include the probe itself plus the electronics for converting probe signal to an electronic signal proportional to airflow.
 3. Accuracy shall be demonstrated at both maximum and minimum airflow rates of operating range.
- D. Operating Limits
1. Probes
 - a. Humidity: 0% to 100% non-condensing
 - b. Temperature (devices in airstream): -20°F to $+160^{\circ}\text{F}$
 2. Transducer/Controller
 - a. Humidity: 5% to 95% non-condensing
 - b. Temperature (devices in airstream): 0°F to $+120^{\circ}\text{F}$
- E. Communication
1. Provide a 4-20 mA or 0-10 VDC signal proportional to total airflow with specified accuracy over entire range.
 2. Provide a 4-20 mA or 0-10 VDC signal proportional to average air temperature.
 3. For duct applications: Temperature and airflow points must be hardwired. Networked points are not acceptable.
 4. For fan inlet applications measuring multiple fans that are part of a single air handling unit:
 - a. Average total airflow points must be hardwired. Networked points are not acceptable.

- b. Also provide airflow and temperature measurements for individual fans. This information may be reported via network connection.

F. Sensor Assembly

- 1. For duct applications: Provide sensor grid with sensor density per manufacturer recommendations as required to achieve specified accuracy. Sensor grid shall span entire area of duct where AFMS is installed.
- 2. For fan inlet applications: Minimum two sensors, with bracket designed to mount across fan inlet cone.

G. Manufacturers

- 1. Ebtron Gold Series or Hybrid Series
- 2. Air Monitor
- 3. Or equal

2.18 AIRFLOW MEASUREMENT STATIONS – FAN WALL

A. General

- 1. Where OEM offers piezo rings for each fan, these are to be used.
- 2. All these piezo rings to be run to a transducer that outputs a single 4-20mA signal, not raw pressure inches for interpretation or calibration later.

B. Application: AHU fan walls

C. Technical Attributes:

- 1. 4-20mA output signal required.
- 2. BACnet or Modbus not required, not a substitute for hardwire feedback for flow. See sequence of operation as to potential fault detection or alarms that may be available through AFMS transducers.
- 3. Temp sensing option not to be a substitute for duct temp sensors.
- 4. Accuracy: +/- 3%

D. Manufacturer:

- 1. AHU OEM
- 2. Or Equal

2.19 AIRFLOW MEASUREMENT STATIONS – Outside Air Measurement

A. General

- 1. Where outside air louvers or bug screen covers entire OA intake, a differential pressure style probe may be used.

B. Application:

- 1. Roof mounted AHU
- 2. Built-up units where the mechanical room walls are the AHU.
- 3. Note: packaged AHU that are placed inside mechanical rooms will not have the OA louvers required for this sensor to work.

C. Installation Options and Attributes:

- 1. Field calibration for the sensor on the as-installed OA louver is required.
- 2. Follow mftr guidelines for high aspect ratio (narrow rectangular rather than square) OA louver conditions.
- 3. Do not provide mftr provided pressure drop inducing wire mesh grill.
- 4. Per mftr recommendations, multiple sensors could be required to cover particularly large built-up mechanical rooms.

D. Technical Attributes:

- 1. 4-20mA output signal required.

2. BACnet or Modbus not required, not a substitute for hardwire feedback for flow. See sequence of operation as to potential fault detection or alarms that may be available through AFMS transducers.
3. Temp sensing option not to be a substitute for duct temp sensors.
4. Accuracy: +/- 3%

- E. Manufacturers
1. Air Monitor OAM II
 2. Or Equal

2.20 CARBON DIOXIDE SENSORS - THERMOSTAT

- A. General
1. Application: the default space CO2 sensor is the OEM thermostat with CO2.
 2. Factory calibrated and set to 0-2000 PPM range
 3. Drift shall not exceed 2%.
 4. Response time shall be 1 minute or less.
 5. Sensor shall not require recalibration for a minimum of 5 years, guaranteed.
 6. C If sensor is found to be out of calibration, DDC Contractor shall provide a replacement unit at no additional cost to the Owner within 5 years of purchase date. C
 7. Rated ambient conditions:
 - a. Air temperature: 32°F - 120°F
 - b. Relative humidity: 0% - 95% non-condensing
 8. Include elevation adjustment
 9. Signal output: 4-20 mA or 0-10 V, or as BACnet networked device on secondary control LAN.
- B. Single Channel ABC Sensor
1. Non-dispersive single beam infrared sensor.
 2. Accuracy: larger of ± 30 PPM or $\pm 3\%$ of reading from 0 to 1,250 PPM at temperatures from 60°F to 90°F
 3. Sensor shall include automatic background calibration (ABC) technology to compensate for the aging of the infrared source.
 4. Manufactures
 - a. DDC OEM
 - b. Or equal

2.21 CARBON DIOXIDE SENSORS - SPECIALTY

- A. General
1. Application: see control dwgs, mechanical details for specific call outs. Common instances include theaters, convention halls, performing arts centers.
 2. Note: combined/integrated with thermostat is not acceptable for these unique applications.
 3. CO2 sensors are delicate optical instruments. Protect from shock. Store in manufacturer's packaging until ready for installation. Recalibration may be required after rough handling.
 4. Detachable base with all field wiring termination on base.
 5. Provide wall-mounted sensors; duct-mounted sensors do not require display.
 6. Provide duct-mounted sensors with aspirating probe.
 7. Factory calibrated and set to 0-2000 PPM range
 8. Drift shall not exceed 2%.
 9. Response time shall be 1 minute or less.
 10. Sensor shall not require recalibration for a minimum of 5 years, guaranteed.
 11. Rated ambient conditions:
 - a. Air temperature: 32°F - 120°F
 - b. Relative humidity: 0% - 95% non-condensing
 12. Include elevation adjustment
 13. Signal output: 4-20 mA or 0-10 V, or as BACnet networked device on secondary control LAN.

- B. Single Channel ABC Sensor
 - 1. Non-dispersive single beam infrared sensor.
 - 2. Accuracy: larger of ± 30 PPM or $\pm 3\%$ of reading from 0 to 1,250 PPM at temperatures from 60°F to 90°F
 - 3. Sensor shall include automatic background calibration (ABC) technology to compensate for the aging of the infrared source.
 - 4. Manufactures
 - a. AirTest TR929x series
 - b. Telaire T8100/8300
 - c. Or equal

2.22 HUMIDITY SENSORS

- A. General
 - 1. Sensor shall be thin film capacitance type.
 - 2. Sensor element shall be field-replaceable without requiring recalibration.
 - 3. Shall include 2-wire transmitter producing a continuous 4-20 mA signal proportional to relative humidity (%RH) or output as required
 - 4. Temperature range: 32°F to 122°F
 - 5. Humidity range: 0% to 100% RH
 - 6. Sensor shall be factory-calibrated and NIST traceable.
 - 7. Resolution: 0.1% RH
 - 8. Repeatability: 0.5% RH at RH < 90%
 - 9. Temperature Effect: Less than 0.06% per °F at baseline of 70°F.
 - 10. Response time at 70°F in still air: Less than 20 seconds
 - 11. Provide sensor with cover suitable for wall (indoor space), duct or outdoor installation as required by application.
 - a. For wall mounting: Aesthetically pleasing ventilated cover, designed for wall box mounting in occupied space, with insulated base.
 - b. For duct mounting: Junction box for wiring connections and gasket to prevent air leakage and vibration noise. Sensor probe shall extend into duct at least 20% of duct width.
 - c. For outdoor installation, provide one of the following:
 - 1) Provide outdoor humidity sensor with integrated flow-through radiation/rain shield. Sensors equipped with this kind of radiation shield (i.e. not fan aspirated) shall not be used for outdoor temperature measurement. For outdoor temperature, provide temperature sensor in aspirated enclosure
 - 2) Provide wall-mounted sensor in aspirated sensor enclosure. Combined measurement of outdoor temperature and humidity is acceptable when using an aspirated enclosure.
 - 12. Sensor shall output relative humidity (%), dewpoint temperature, or wetbulb temperature as indicated on control drawings or as required by the application.
 - a. Contractor shall select the model/options to provide required output, or shall configure sensor to provide required outputs, as appropriate to the sensor being used.
 - b. Calculated outputs (dewpoint temperature, wetbulb temperature) for outdoor installation shall require an aspirated enclosure (This ensures accurate measurement of drybulb temperature, which is required for accurate calculation of the dewpoint or wetbulb temperatures.)
- B. Standard Accuracy (3%)
 - 1. Application: AHU where shown on controls diagrams
 - 2. Accuracy at 70°F: no worse than $\pm 3\%$ over 0% - 90% RH; $\pm 5\%$ over 90% - 100% RH
 - 3. Drift: no more than 1% per year
 - 4. Manufacturers
 - a. BAPI

- b. Kele
- c. Veris

2.23 CURRENT SWITCH

- A. Solid-core or split-core
- B. Range as required by application
- C. Adjustable trip point
- D. Switch:
 - 1. Solid state
 - 2. Normally open
 - 3. Relay output: minimum 120 VAC or VDC, 0.3 Amps.
 - 4. Zero off state leakage
- E. Low Frequency Limit: 6 Hz
- F. LED trip indicator
- G. May be used to start other devices if so indicated on Building Automation Drawings.
- H. Manufacturers
 - 1. Senva C-1220/1320/2220/2320
 - 2. Veris Industries H-308/608/708/808/908
 - 3. RE Technologies CS1150A/SCS1150A
 - 4. Or equal

2.24 WIRELESS WINDOW CONTACTS

- A. General:
 - 1. Basis of design: Viconics ZigBee wireless door/window contact
 - 2. Note the presence of this wireless spec section does not eliminate the option for hardwired, but wireless is preferred. If hardwire is used, linking multiple sensors within the same zone in series is permissible.
 - 3. Enoccean is acceptable if native to the DDC controls without using 3rd party gateways.
 - 4. These must be installed on all automated or manual windows.
 - 5. Note: if the only operable windows in the space are automated, then using status of the windows through a window control system integration or dry contact input from the associated window controller is acceptable. However, this is not expected to be a cost effective solution.
 - 6. Linking multiple sensors within the same zone in series is permitted as any open window is a trigger.
 - 7. Per Title 24 2019, any open window is to relax the heating and cooling setpoints approx. +/- 20°F, which essentially shuts down all mechanical cooling/heating. Fan shall remain on for ventilation air.
- B. Manufacturers:
 - 1. Basis of design is white labeled Enoccean or Zigbee products from the DDC mftr.
- C. Technical Attributes:
 - 1. Battery lifetime in years >2
 - 2. Battery low information If capacity is less than 10%
 - 3. Frequency of signal (default): Every 10 minutes
 - 4. Communication protocol: ZigBee
 - 5. Operating temp: -10°C to 50°C
 - 6. Installation: screws, or adhesive tape

2.25 WIRELESS OCCUPANCY SENSORS

- A. General:
1. Note the presence of this wireless spec section does not eliminate the option for hardwired, but wireless is preferred.
 2. EnOcean is acceptable if native to the DDC controls without using 3rd party gateways.
 3. A ceiling mounted sensor must be added to the center of the room ceiling.
 4. Ceiling mounted sensor field of view of diameter must be no less than any perpendicular wall width. The corners of the room do not need to be in the view of the sensor.
 5. Occupancy sensors to be located such that the main entrance to the room is within the view radius of the sensor.
 6. Per Title 24 2019, if any zone is un-populated for 5 min (adj), the FCU is to relax the heating and cooling setpoints approx. +/- 20°F, which essentially shuts down all mechanical cooling/heating. Fan shall remain off, until these very relaxed setpoints are exceeded during occupied times.
- B. Manufacturers:
1. Basis of design is white labeled EnOcean or Zigbee products from the DDC mfr.
 2. substitute.
- C. Minimum Features:
1. Embedded PIR sensor, built into the thermostat is acceptable in private offices only
 2. All other instances shall use a ceiling mounted occupancy sensor connected through hardwire input or ZigBee wireless connection.
 3. Lighting integration for occupancy is not desirable. Design intent is for every HVAC zone to execute the occupancy sequence with its own sensors independent of other systems.
 4. Sharing the hardwire relay output from the lighting control system is not permissible.
 5. Controller shall have an adjustable “Stand-by timer” integrated to change the occupancy mode from “Occupied” to “Stand-by” if no motion is detected.
 6. Additionally, the controller shall drop from “Stand-by” mode to “Unoccupied” if no motion is detected for a certain amount of time during “Stand-by” mode. Both timers are adjustable.
 7. “Stand-by” mode shall have adjustable heating and cooling set points. Stand-by set points are intended to be set a few degrees less or more than “Occupied” set points to ensure a quick recovery to “Occupied” set points when motion is detected.
- D. Technical Attributes:
1. Detection range Ceiling: diameter = 4m (installation height 2.5m)
 2. Angle of detection Ceiling: 360°
 3. Power: battery
 4. Battery lifetime in years >2
 5. Battery low information: If capacity is less than 10%
 6. Frequency of detection signal (default): Every 10 minutes
 7. Communication protocol: ZigBee
 8. Operating temp: -10°C to 50°C
 9. Installation: screws, or adhesive tape

2.26 WIRELESS SPACE CO2 SENSING

- A. General:
1. See floor plans, control diagrams and sequence of operations for where space CO2 is required.
 2. Where sequence of operations call for space CO2 to control the economizer and only the economizer, this spec section is not applicable unless the Thermostat with IO for the VRF is also controlling the economizer.
 3. Space CO2 is not intended to replace the space occupancy sensor.
 4. Additional temp and humidity reporting is not intended to be used.

5. Note the presence of this wireless spec section does not eliminate the option for hardwired, but wireless is preferred.

B. Manufacturers:

1. Basis of design is the Viconics SED-CO2-G-5045
2. Or equal hardwire or ZigBee sensors

C. Technical Attributes:

1. Operating Principle Non-dispersive infrared (NDIR)
2. Operating temperature: 32°F to 122°F
3. Measurement range: 0 to 5000 ppm
4. Measurement transmission intervals: 2.5 minutes (day), 10 minutes (evening)
5. Note: Battery life will be reduced should interval be shortened
6. CO2 accuracy at NTP $\pm 60\text{ppm} + 3\%$ of reading (400 - 2,000ppm range)
7. CO2 calibration: automatic calibration
8. CO2 resolution at NTP $\pm 20\text{ppm}$ at 800ppm
9. Transmission protocol: Zigbee
10. Transmission range: 90ft indoor
11. Battery lifetime: 5+ years

2.27 HARDWIRE DRIP PAN LEAK SENSING - PRIMARY

A. General

1. Intended to be the primary source of leak detection.

B. **Manufacturers:**

1. OEM is preferred
2. Refco - Aquaswitch 3000543
3. Veris – MX1B
4. Or equal

C. Technical Attributes:

1. Dry contact input.

2.28 WIRELESS DRIP PAN LEAK SENSING - SECONDARY

A. General:

1. Note the presence of this wireless spec section does not eliminate the need for hardwired drip pan sensor as a primary. Where wireless is secondary sensor for data halls, or condensate pipes running over sensitive equipment, a wireless backup is acceptable.
2. See control diagrams for alternate locations where other types of drip pan sensing may be required.

B. **Manufacturers:**

1. Basis of design is ZigBee communicating SED-WLS-G-5045
2. Or equal hardwire or ZigBee sensors

C. Technical Attributes:

1. Battery lifetime in years >2
2. Battery low information If capacity is less than 10%
3. Frequency of signal (default): Every 10 minutes
4. Operating voltage/battery type 3V / LR03 AAA (2pcs)
5. Communication protocol: ZigBee 3.0 HA

2.29 HARDWIRED WINDOW CONTACT

A. General

1. Per Title 24 2019, operable windows must be monitored for HVAC setbacks.

B. Manufactures

1. VRF OEM
2. DDC mftr compatible with VAV or thermostat
3. Tane – MET-200

2.30 DUCT SENSORS

- A. Temperature Sensors
 1. Single Point Duct Sensors
 - a. Install probe at approximate midpoint of duct height.
 - b. If installing near a coil:
 - 1) Upstream of coil, install a minimum of 6 inches from coil.
 - 2) Downstream of coil, install a minimum of 12 inches from coil if possible, 6 inches absolute minimum.
 - 3) No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements.
- B. Averaging Duct Sensors
 1. Install sensor in serpentine manner vertically across duct.
 2. Support at each bend with capillary clip.
 3. Where located in front of filters (e.g. mixed air temperature sensor), maintain access for filter removal.
- C. Outdoor Air Sensors
 1. Install sensor in aspirating enclosure.
 2. Installation location shown on contract drawings is approximate.
 3. Contractor is responsible for selecting actual installation location to provide accurate readings without distortion from solar or building influences.
 - a. Good locations are shielded from the sun and away from reflective surfaces, air intakes and exhausts, and heat producing equipment.
 - b. Poor locations include above sun-exposed walls, near windows, doors and exhaust vents, under eaves, or near equipment.
 - c. If no good location is available, notify the Engineer of Record.
- D. Differential Pressure Sensors
 1. Filter differential pressure transducers shall be mounted on outside of filter housing or filter plenum with display clearly visible.
 2. Terminate tubing at static pressure probe or port selected based on application. Probes shall be securely fastened.
 3. Identify and label all pressure transducers.
- E. Duct static pressure sensors (as applicable)
 1. shall be installed as follows:
 - a. Connect low-pressure (reference) port to building pressure sensor high-pressure tubing with tee fitting. If there is no building pressure sensor, terminate low pressure tubing in appropriate location for building ambient pressure measurement.
 - b. Connect high-pressure port to duct pressure probe.
 - c. Install probe in location as shown on contract drawing mechanical plans. If installation location is unclear or not feasible, contact Engineer of Record for clarification.

2.31 ACTUATORS

- A. Damper Actuators
 1. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- B. Valve Actuators
 1. Use only manufacturer-approved coupling adapters, if one is required.

2. Install so that actuators, wiring and tubing connections are accessible for maintenance.
 3. If possible, install valve so that the position indicator is visible from floor or other readily accessible location. However, do not install valve with steam pointing below horizontal or down.
- C. Normal Position and Fail-Safe
1. For all actuators, normal position is the position with zero control signal.
 2. Fail-safe actuators shall assume normal position upon loss of power.

2.32 BACNET RELAYS

- A. General
1. Use of a communicating relay to provide enable and status for small EFs or SFs is acceptable.
 2. Communicating relays shall use BACnet MS/TP.
- B. **Manufacturers:**
1. RIB – RIBTW2402B-BC - basis of design
 2. Or equal.
- C. Technical Attributes:
1. # Relays & Contact Type: One (1) SPDT Continuous Duty Coil
 2. Expected Relay Life: 10 million cycles minimum mechanical
 3. Operating Temperature: -30 to 140° F
 4. Humidity Range: 5 to 95% (noncondensing)
 5. Operate Time: 18ms
 6. Wires: 16", 600V Rated
 7. Approvals: CE, UL Listed, C-UL, RoHS
 8. Housing Rating: UL Accepted for Use in Plenum, NEMA 1
 9. Contact Ratings:
 - a. 20 Amp Resistive @ 277 Vac
 - b. 20 Amp Ballast @ 277 Vac
 - c. 16 Amp Electronic Ballast @ 277 Vac (N/O)
 - d. 10 Amp Tungsten @ 120 Vac (N/O)
 - e. 1110 VA Pilot Duty @ 277 Vac
 - f. 770 VA Pilot Duty @ 120 Vac
 - g. 2 HP @ 277 Vac
 - h. 1 HP @ 120 Vac
 10. Power Input Ratings:
 - a. 81 mA @ 24 Vdc
 - b. 111 mA @ 24 Vac
 - c. 96 mA @ 120 Vac
 11. Power Input:
 - a. 24 Vac/dc ; 120 Vac ; 50/60 Hz
 12. Network Media: Twisted Pair 22-24AWG, shielded
 13. Baud Rate: 9600, 19200, 38400, 57600, 76800, 115200 (DIP Switch Selectable)

2.33 CONTROL RELAYS

1. All control relays shall be UL listed, enclosed, with LED energized indicator.
2. All relays shall have contact rating, configuration and coil voltage suitable for the application.
3. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
4. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.
5. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

2.34 TRANSFORMERS AND POWER SUPPLIES

- A. General / Application
 - 1. Power supplies for all OEM VRF controllers to be by the VRF mfr.
 - 2. Auxiliary control devices (Example: BACnet relay for restroom exhaust fan) that cannot be also be powered from the VRF low voltage transformer will need a separate power supply.
 - 3. Design intent is to have power transformers next to control cabinets rather than within control cabinets.
- B. Manufacturers
 - 1. Basis of design - Functional Devices
 - a. PSH500A-LVC with separate 120V & 24V compartments
 - b. PSH100AB10 with outlet, off switch and 10 amp breaker
 - 2. Or Equal
- C. Technical Attributes
 - 1. Enclosure Options:
 - a. Self-contained enclosure with cover separating 120V or higher voltage from 24V sections.
 - b. Finger guard between 120V+ and 24V sections mandatory.
 - c. Bare transformer for mounting in another enclosure is not an acceptable substitute as this raises the entire encloser to 120V rating.
 - 2. Secondary voltage circuits: 100 VA minimum per circuit.
 - 3. On/Off switch: mandatory on secondary, optional on primary.
 - 4. Circuit indicators: light indicators for each circuit
 - 5. Fuse: option feature, other fuses may be used for individual devices if necessary.
 - 6. Plug outlet: convenience receptacle is optional feature. Note: not to be confused with wall plug input to primary coil.
 - 7. Primary coil contact: dry contact, wall plug is not acceptable
 - 8. Secondary coil contact:
 - 9. Enclosure weather rating: NEMA 1 for indoor. Separate NEMA 4 enclosure required for outdoor mounting.

PART 3 - INSTALLATION

3.01 GENERAL

- A. Subject to direction by the General Contractor, DDC Contractor shall perform Work in accordance with the general sequence of events. If it is necessary to deviate substantially from this schedule, DDC Contractor shall notify Commissioning Authority and Engineer of Record.
- B. DDC Contractor shall perform all Work under this Section in accordance with the manufacturer's instructions and in Division 23. DDC Contractor shall in addition observe the following requirements:
 - 1. Wires attached to sensors shall be sealed against bulk air movement in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
 - 2. Sensors which provide data used to maintain a setpoint with variable-speed equipment (e.g. duct pressure sensor used for fan speed control, or end-of-loop differential pressure used for pump speed control) shall be hardwired directly to the same controller that controls the variable-speed equipment, which shall also be the controller where the variable speed control loop resides.

3.02 ACTUATORS

- A. AHU Damper Actuator Installation
 - 1. The actuator shall be direct coupled to shaft, without connecting linkage or jackshaft.
 - 2. Links or jackshafts are not acceptable unless specifically indicated in Contract Drawings.

3. If installation requires linkages due to mechanical or space constraints, notify Engineer of Record in writing.
4. For multiple-section dampers, provide one actuator for each section.
5. Pre-compress dampers that have blade seals: Power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage; or follow manufacturer's instructions to achieve same effect.
6. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

B. Central Plant Valve Actuator Installation

1. Install damper to valve shaft with a "keyed" or splined connection to prevent rotational slippage.
2. Use only manufacturer-approved coupling adapters, if one is required.
3. Compression-clamping actuator to a round valve shaft is not acceptable.
4. Install so that actuators, wiring and tubing connections are accessible for maintenance.
5. If possible, install valve so that the position indicator is visible from floor or other readily accessible location. However, do not install valve with steam pointing below horizontal or down.

3.03 WATER SENSORS AND DEVICES

A. Immersion Temperature Sensors

1. All temperature sensors in pipes shall be installed in thermowell with thermally-conductive grease. Direct immersion installation is not acceptable.
2. Thermowell shall penetrate pipe by lesser of 8 inches or half pipe diameter. For small pipes, well shall be installed in an elbow into pipe length.
3. Insulate top of thermowell with a patch of closed-cell insulation, to provide a complete thermal break but allow easy access to sensor.
4. Provide sufficient wiring (or flexible conduit, per installation location) to allow sensor to be removed from thermowell for calibration or replacement.

B. Immersion Pressure Sensors

1. Install with manifold that provides for isolation and venting. Pressure sensors shall have 3-valve manifold; differential pressure sensors shall have 5-valve manifold.
2. Manifold shall permit removal of sensor without shutting down hydronic system.
3. Manifold vent ports shall be usable as test ports, or provide separate test ports adjacent to sensor.

C. Flow Meters

1. Install per manufacturer's recommendations for unobstructed straight length of pipe both upstream and downstream of sensor.
2. If sufficient straight pipe is not available, notify Engineer of Record.
3. For Insertion-Type meters, install using manufacturer-provided depth gauge to ensure that sensor is correctly positioned at center of pipe. Always place depth gauge against exterior of pipe, not against pipe insulation.
4. Test meter per the manufacturer's startup and commissioning recommendations.
5. Complete all manufacturer's startup documentation and include with Pre-Functional Test report

3.04 AIR SENSORS AND DEVICES

A. Temperature Sensors

1. Single Point Duct Sensors

- a. Install probe at approximate midpoint of duct height.
- b. Install such that probe penetrates minimum 20% of duct width, to avoid boundary layer.
- c. If installing near a coil:
 - 1) Upstream of coil, install a minimum of 6 inches from coil.

- 2) Downstream of coil, install a minimum of 12 inches from coil if possible, 6 inches absolute minimum.
 - 3) No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements.
2. Averaging Duct Sensors
- a. Install sensor in serpentine manner with a minimum of four vertical passes ("M" pattern), covering full width and height of duct.
 - b. Support at each bend with capillary clip.
 - c. Where located in front of filters (e.g. mixed air temperature sensor), maintain access for filter removal.
 - d. Provide minimum one sensor per AHU module. A single sensor shall not span coil segments. Wire sensors to provide leaving air temperature reading on a per-coil basis.
 - e. If installing near a coil:
 - 1) Upstream of coil, install a minimum of 6 inches from coil.
 - 2) Downstream of coil, install a minimum of 12 inches from coil if possible, 6 inches absolute minimum.
 - 3) No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements.
3. Outdoor Air Sensors part of Weather Station
- a. Install sensor in aspirating enclosure.
 - b. Installation location shown on Contract Drawings is approximate.
 - c. DDC Contractor is responsible for selecting actual installation location to provide accurate readings without distortion from solar or building influences.
 - 1) Good locations are shielded from the sun and away from reflective surfaces, air intakes and exhausts, and heat producing equipment.
 - 2) Poor locations include above sun-exposed walls, near windows, doors and exhaust vents, under eaves, or near equipment.
 - 3) If no good location is available, notify Engineer of Record.
- B. Room Sensors and Thermostats
1. Room sensors and thermostats shall be installed on concealed junction boxes properly supported by wall framing.
 2. Install all devices with insulated base.
 3. For sensors mounted in exterior walls, seal all junction box openings with mastic sealant and pack junction box with insulation.
 4. For sensors on exposed unfurred columns, use Wiremold or equal raceway that is smallest required to enclose wiring and Wiremold or equal junction boxes that are narrowest required to enclose sensor and wiring connections. Color shall be per the architect; submit for approval prior to installation.
 5. Install sensors in locations as shown on Contract Drawing mechanical floorplans. If installation in indicated location is not feasible, notify the Engineer of Record.
 6. Unless otherwise noted on Contract Drawings, wall-mounted sensors shall be installed at same centerline elevation as adjacent electrical switches, 4 feet above the finished floor where there are no adjacent electrical switches, and within ADA limitations.
 7. Wall mounted CO2 sensors shall in all cases be installed between three and six feet above finished floor, to comply with code requirements.
- C. Differential Pressure Sensors
1. Pressure transducers shall be installed in control enclosures. Do not install on monitored equipment, ductwork or other location subject to vibration.
 - a. Exception: Terminal unit transducers may be installed on terminal unit.
 - b. Exception: Filter differential pressure transducers shall be mounted on outside of filter housing or filter plenum with display clearly visible (replaces Magnehelic).
 2. Terminate tubing at static pressure probe or port selected based on application. Probes shall be securely fastened. Pitot tips shall point into directly airflow.

3. Install both high-pressure and low-pressure tubing with capped tee fittings near pressure transducer, for use as test ports.
4. Duct static pressure sensors shall be installed as follows:
 - a. Connect low-pressure (reference) port to building pressure sensor high-pressure tubing with tee fitting. If there is no building pressure sensor, terminate low pressure tubing in appropriate location for building ambient pressure measurement.
 - b. Connect high-pressure port to duct pressure probe.
 - c. Install probe in location as shown on Contract Drawing mechanical plans. If installation location is unclear or not feasible, contact Engineer of Record for clarification.
5. Building static pressure sensors shall be installed as follows:
 - a. Connect low-pressure (outdoor ambient) port to outdoor pressure probe located outside at high point of building, sheltered from wind.
 - b. Connect high-pressure (building ambient) port to wall-plate pressure port appropriately located to provide consistent and accurate building pressure signal. Do not locate near elevators, exterior doors, atria, or HVAC diffusers.
6. Underfloor plenum pressure sensors shall be installed as follows:
 - a. Connect low-pressure (reference) port to wall-plate pressure port located adjacent to zone thermostat. Tubing may alternatively terminate inside thermostat, if cover has openings to allow free air flow.
 - b. Leave high pressure port open to plenum.
 - c. Install pressure transmitter in underfloor plenum below low-pressure port location. Do not locate near plenum supply outlet.

3.05 SWITCHES AND STATUS INDICATORS

- A. Window Switch – as applicable, see dwgs for locations of manually or automated operable windows.
 1. Where there is more than one switch in a ventilation zone, wire in series so that windows are indicated as open when any window is open and indicated as closed when all are closed.
 2. All wiring shall be concealed in mullions and wall cavity to the extent possible. Review wiring routing details in mullions with window manufacturer. Any wiring exposed to view shall be reviewed and approved by Owner prior to installation.
- B. Leak Detectors, Spot or Area
 1. Set detector to react to 1/8" depth of water accumulation, maximum, unless otherwise indicated on Building Automation Drawings.
 2. Secure detector per manufacturer instructions.
 3. Do not use liquid water detector for applications where a condensation detector is indicated.
- C. Condensation Detector
 1. For pipe installation, install detector to bare metal pipe, remove insulation for 2" around detector, to allow free circulation of air to detector. Clean pipe surface.
 2. For flat surface installation, install detector flat to back side of chilled beam/radiant panel, or to interior bottom surface of drip pan.
 3. Do not use condensation detector for applications where a liquid water detector is indicated.

END OF SECTION

**SECTION 25 5000
BUILDING AUTOMATION HARDWARE AND NETWORKING**

PART 1 - GENERAL

1.01 SUMMARY

- A. The DDC Contractor shall furnish and install a complete Direct Digital Control Building Automation System in accordance with Contract Drawings, this Section, and other Division 25 Sections issued with this Specification.
- B. DDC System shall consist of an internetwork of ANSI/ASHRAE 135 native BACnet DDC devices, interfaces and software, as well as sensors, actuators, control devices, enclosures, interconnecting conduit and wiring.
- C. DDC System shall monitor and/or control the following systems in accordance with Building Automation drawings and Section 25 90 00 "Building Automation Sequences of Operations"
 - 1. HVAC Systems
 - 2. Plumbing Systems
- D. Coordinate with other trades as required to fulfill requirements of Contract Drawings and this Section.
 - 1. Furnish selected control devices to equipment and systems manufacturers for factory installation and to contractors of other trades for field installation under other Sections and Divisions. Supervise and coordinate the installation of components furnished under this Section but installed under other Divisions of the Specification.
 - 2. Coordinate with equipment manufacturers and contractors of other trades all installation, connection, and interface details required to integrate products by others (including but not limited to VFDs, gateways, and package unit controllers) to the DDC System.
 - 3. Test and Balance: Coordinate with TAB Contractor to determine setpoints and other parameters required to program Sequences of Operations. Assist TAB Contractor in balancing tasks which require DDC System interaction
 - 4. Life Safety: The DDC System is not a life-safety system. Smoke alarm and smoke control system are by others. DDC Contractor shall provide hardwire interlock connections to the smoke/fire system, and shall connect to smoke detectors, smoke/fire alarm systems, and/or smoke control dampers for monitoring purposes only, as shown in Building Automation drawings.
 - 5. Lighting Control: Lighting control system is provided by Division 26 and is separate and distinct from DDC System. There shall be no connection between the DDC System and the lighting control system.
 - 6. Commissioning: Perform commissioning activities and assist Commissioning Authority and/or Commissioning Coordinator in the execution of commissioning tasks
- E. To facilitate the Work under this Section, a searchable digital version of this document will be provided to the DDC Contractor upon request to the Engineer of Record.
 - 1. Searchable digital version is formatted with PDF "bookmarks" corresponding to the outline levels of the document, as an aid to navigation.
 - 2. DDC Contractor is strongly encouraged to request this digital version if it is not provided through standard channels.
- F. If there are questions or concerns, please contact the Engineer of Record for clarification.
- G. DDC Contractor shall be familiar with and shall follow the requirements laid out in the latest version of the Owner's controls requirement.

1. In the event of a conflict between this Section and the Owner's Requirements, DDC Contractor shall request clarification from the Owner and the Engineer of Record.

1.02 DDC SYSTEM REQUIREMENTS

- A. Open and Non-Proprietary: The DDC BAS shall be based on open standards and protocols designed to maximize interoperability and future flexibility. Any equipment, device or implementation decision which "locks in" the system to a single manufacturer or product line is not acceptable.
 1. All DDC devices shall be ANSI/ASHRAE 135 native BACnet devices.
 - a. All DDC devices shall be tested, certified, clearly stamped and listed by the BACnet Testing Laboratories (BTL), or the vendor shall provide proof that the device has been submitted to BTL for testing, prior to the bid date for this Project. (Throughout this Section, any requirement that a device must be BTL-listed shall also be satisfied by proof that the device has been submitted to BTL for testing.)
 - b. The BACnet operating stack must be embedded directly in each individual DDC device at the media access controller level and in all operator interface and configuration applications.
 - c. The use of communication gateways, bridges, and protocol translators is restricted.
 2. BACnet devices shall not use proprietary extensions, objects, services or properties (as described in Chapter 23 of ANSI/ASHRAE 135-2016) to replace basic functions already provided by BACnet. DDC system shall use standard BACnet objects, properties, services and functions whenever practical.
 - a. Exception: Proprietary extensions that provide functionality that is part of the current revision of BACnet are acceptable in devices which were BTL listed under an earlier version of BACnet which lacked the function(s) in question.
- B. Modular and Expandable:
 1. The DDC system shall be modular in nature and implemented in such a manner that it can be expanded in both capacity and functionality through the addition of DDC controllers, devices and wiring.
 2. All software assets created for the project shall be available for re-use without additional licensing or cost to the Owner.
 3. DDC System shall be designed, and licenses shall be provided, to support expansion of the DDC System to an ultimate capacity greater than that originally installed.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC with all state and local amendments, by a qualified testing agency, and marked for intended location and application.

1.03 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section, except as specifically noted in this Section.
- B. Related Mechanical and Controls Specifications
 1. Section 23 00 00 "HVAC General Requirements"
 2. Section 23 05 93 "Testing, Adjusting and Balancing for HVAC"
 3. Section 23 08 00 "Mechanical System Commissioning"
 4. Section 25 30 00 "Building Automation Sensors and Control Devices"
 5. Section 25 90 00 "Building Automation System Sequence of Operations" part 1-3, 4
 6. Section 26 29 23 "Variable-Frequency Motor Controllers"
- C. Related Other Specifications
- D. Related Specifications
 1. Division 1

- 2. Division 23
- 3. Division 25 – all other sections
- 4. Division 26
- 5. Division 27
- 6. Division 28

1.04 DEFINITIONS

- A. Accessible: A location that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials.
- B. AHJ: The Authority Having Jurisdiction. All requirements and exceptions noted in this Section are subject to the approval of the AHJ.
- C. ARCnet: Attached Resource Computer Network. A network protocol for low-speed communication. It is able to support a variety of wiring standards.
- D. BACnet ARCnet: Datalink standard that uses a token-bus scheme to coordinate the transmission of BACnet messages among devices in a local area network.
- E. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network. Unless otherwise noted, all references are to the most recent version of the standard.
- F. BACnet/IP: Datalink standard that uses a reserved UDP socket to transmit BACnet messages over peer-to-peer networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
- G. BACnet MS/TP: Datalink standard that uses token passing to coordinate the transmission of BACnet messages between a master device and one or more slave devices
- H. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
- I. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- J. Binary: Two-state signal where a high signal level represents “ON” or “OPEN” condition and a low signal level represents “OFF” or “CLOSED” condition. “Digital” is sometimes used interchangeably with “Binary” to indicate a two-state signal.
- K. COV: Change of value.
- L. E/P: Voltage to pneumatic.
- M. Furnish: To purchase, procure, acquire and deliver complete with related accessories. Synonymous with Supply.
- N. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- O. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals are discrete and generally represent on/off commands, or two position operating or alarm status signals. “Digital” (DI and DO) is sometimes used interchangeably with “Binary” (BI and BO).
- P. IT LAN/Owner’s LAN: Refers to the Project’s Information Technology network, used for normal business-related e-mail and Internet communication. Distinct from control networks.

- Q. LAN: Local area network, a digital data communication network typically confined to a single building or small campus.
- R. Low Voltage: As defined in NEC with all state and local amendments for circuits and equipment operating at less than 50 V or for remote-control, power-limited signaling circuits.
- S. Modbus: An open protocol for exchange of process data.
- T. NiCS: Niagara Compatibility Statement
- U. Operator's Interface Device: Provides the Operator with the ability to interact with the DDC System. Specifically, a hardware device.
- V. Operator's Workstation: A computer that provides the user's interface with the DDC System. May also refer to the user interface software package, whether hosted on a controller or on a PC.
- W. POT: Portable Operator's Terminal, a handheld operator interface device with integral keypad or touch screen, designed specifically for interface with DDC System by a technician in the field.
- X. Router: Device connecting two or more networks at network layer.
- Y. Request-based Trim & Respond logic: A reset scheme that periodically resets the setpoint at an "upstream" system (e.g. air handler) using demand-based Requests from "downstream" devices (e.g. terminal units). The setpoint is adjusted at a defined, user-adjustable time-step frequency. Downstream devices can be made to have more or less impact on the reset by adjusting the device's Importance multiplier (default = 1). For more detail and a worked example, see Sequences of Operations.
- Z. System Software: Refers to software providing engineering, operator's interface, configuration/programming, and data collection/analysis functions. System Software functions may be provided by a single or multiple pieces of software, hosted on a variety of platforms.
- AA. UPS: Uninterruptible power supply.
- BB. WAN: Wide area network, a telecommunications network that extends over large geographic distances, such as connecting multiple buildings or campuses in disparate locations

1.05 CODES AND STANDARDS

- A. Workmanship, materials and equipment together with the resultant complete and operational DDC System shall be in compliance with the Authorities Having Jurisdiction (AHJ) for the Project and the most restrictive of applicable local, state and federal codes and ordinances in cooperation with these plans and Specifications.
- B. At a minimum, the installation shall comply with the applicable Sections of the current editions in effect thirty (30) days prior to receipt of bids of the following codes:
 1. ANSI/ASHRAE Standard 135: Data Communication Protocol for Building Automation and Control Networks (BACnet)
 2. California Code Title 24, if Project is located in California.
 3. National Electric Code (NEC) with all state and local amendments

1.06 QUALIFICATIONS AND QUALITY ASSURANCE

- A. DDC System Manufacturer Qualifications:
 1. Nationally recognized manufacturer of DDC systems and products from approved manufacturers
 2. Has produced DDC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
 3. DDC systems and products that have been successfully tested and in use on at least ten past Projects of comparative size and complexity.

4. Has complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Has full-time in-house employees for the following:
 - a. Product research and development.
 - b. Product and application engineering.
 - c. Product manufacturing, testing and quality control.
 - d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
 - e. Owner operator training.
6. All products used in this installation shall be new and currently under manufacture. Spare parts shall be available for at least five years after completion of this contract.
7. All products shall have been available from the manufacturer for a minimum of 6 months prior to date of proposal and previously installed and proven effective in installations of similar nature, not including test sites. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner in writing.
8. All BACnet devices must either be certified as compliant with the BACnet standard through a listing by the BACnet Testing Laboratory (BTL) or the vendor must supply proof of having submitted the device for testing by BTL.
9. The DDC system and components shall be listed by Underwriters Laboratories UL 916 as an Energy Management System.

B. DDC Contractor Qualifications:

1. The Installer shall have an established working relationship with the Control System Manufacturer for at least three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Engineer in writing. Spare parts shall be available for at least 5 years after completion of this contract.

C. Instruments for Calibration and Testing

1. All instruments required for field calibration, verification and testing of control devices, except for terminal unit balancing, shall be provided by the DDC Contractor.
2. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.
3. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (for example if field device is $\pm 0.5\%$ accurate, test equipment shall be $\pm 0.25\%$ accurate over same range).

1.07 SUBMITTALS

- A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Engineer of Record.
- B. Submit drawings and product data as hereinafter specified. Requirements of this specification supersede and take precedence over conditions in Division 1 or Division 23.
- C. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers.
- D. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary.

Provide a copy of all related correspondence and permits to the Owner and include with O&M/Closeout documentation.

- E. Submittals shall be provided in digital format.
1. Product cutsheets, test forms and other text documents shall be provided in word-searchable digital format. Acceptable formats are MS Word, PDF (generated from another electronic document and word-searchable; scans of paper documents are not acceptable), and HTML; other formats require approval prior to submission.
 2. For submittals, drawings and schematics shall be provided in PDF format. For completion documents, drawings shall be provided in PDF.
 3. Sequences of operations shall be submitted in MS Word format.
 4. Hardcopy (paper) submittals are not acceptable and shall not be provided except as noted in Closeout Submittals
- F. Submission and Resubmission Procedure
1. Optional Pre-Submittals: At DDC Contractor's option, electronic submittals indicated below may be submitted unofficially via email directly to the Engineer of Record for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time, and to provide a venue to discuss technologies, products, designs or implementation strategies that are novel or unique.
 2. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 230923-01 REVISION 1.
 3. Submit one copy of submittal in electronic format specified under each submittal package below.
 4. When revised submittals are returned to EOR, on the first page provide the following:
 - a. Response to all of the EOR comments requiring resubmission
 - b. Revise initial submittal to resolve review comments and corrections.
 - c. Provide complete responses to comments or suggestions which are, in the opinion of the DDC Contractor, not practical to implement.
 - d. Indicate any changes that have been made other than those requested.
 - e. Clearly identify resubmittal by original submittal number and revision number.
 5. Resubmit revised submittals until no exceptions are taken.
 6. Once submittals are accepted with no exceptions taken, provide
 - a. Complete submittal of all accepted drawings and products in a single electronic file.
 - b. Copies for coordination with other trades, if and as required by the General Contractor or Owner's Representative.
- G. Submittal Schedule:
1. Submittal schedule shall be as follows unless otherwise directed by the Owner's Representative. Each entry in the following list is a separate submittal (some are "packages" of multiple items while others are individual items):
 - a. Submittal Package 0 (Qualifications) shall be submitted before acceptance as responsive and compliant bidder.
 - b. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by General Contractor or in bid documents.
 - c. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.
 - d. Where applicable: submit Setpoint Determination Report as soon as it is complete. Do not perform setpoint determination process until Pre-Functional Tests have been reviewed and accepted.
 - e. Where 3rd Party Commissioning is required: submit BAS Functional Test Report as soon as it is complete.

- f. Submit Training & Operations Materials shall be submitted no less than 14 days prior to conducting first training class.
 - 2. All DDC submittals are considered “large and complex”. Allow 15 working days for review, unless Engineer of Record agrees to accelerated schedule in writing. This supersedes the submittal review period defined in Division 01.
 - 3. If project schedule requires deviation from this schedule, DDC Contractor shall provide notice along with a proposed alternative schedule including expected dates for each submission.
- H. Submittal Package 0 (Qualifications)
- 1. Provide DDC System manufacturer qualifications
 - 2. Provide DDC Contractor and key personnel qualifications
 - a. Names and resumes of key personnel assigned to the Project
 - b. Brief description of qualifying past Projects including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function
 - c. Description of qualifying past Projects' DDC systems, noting similarities to Project scope and complexity indicated
 - d. Owner, engineer and contractor contact information for qualifying past Projects, including name, phone number and email address
 - 3. Format: Word-searchable format.
- I. Submittal Package 1 (Hardware, Shop Drawings, Coordination Plans, Schedule)
- 1. Hardware
 - a. Organize by Specification sub-Section and device tags as shown on Contract Drawings.
 - b. Do not submit products that are not used even if included in Specifications.
 - c. Include a summary table of contents listing for every submitted device:
 - 1) Tab of submittal file/binder where submittal is located
 - 2) Specification Paragraph, down to the lowest applicable heading number.
 - 3) Whether device is per Specifications or deviates from Specification.
 - 4) Whether device is a listed product or a substitution.
 - 5) Manufacturer
 - 6) Model number
 - 7) Device accuracy (where applicable)
 - 8) Accuracy as installed including wiring and A/D conversion effects (where applicable)
 - d. In Bill of Materials or on a separate sheet, provide a schedule of all control valves including the unique equipment identifier, valve size, dimensions and installation/maintenance clearance, model number, close-off rating, flow, CV, pressure drop, pressure rating and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close and seal the valve at design conditions. Indicate normal positions of fail-safe (i.e. spring-return) valves.
 - e. Bill of Materials: With each schematic, provide a table of all equipment, controllers, devices and sensors to be provided and/or used including:
 - 1) Device tag as indicated in the schematic and used in actual field labeling.
 - 2) Device tag as indicated in the Contract Drawings if it differs from schematic device tag
 - 3) Description
 - 4) Proposed manufacturer and model number
 - 5) Range
 - 6) Quantity
 - f. In Bill of Materials or on a separate sheet, provide a schedule of all control valves including the unique equipment identifier, valve size, dimensions and installation/maintenance clearance, model number, close-off rating, flow, CV,

pressure drop, pressure rating and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close and seal the valve at design conditions. Indicate normal positions of fail-safe (i.e. spring-return) valves.

- g. Physical details for each control panel and/or enclosure, drawn to scale and showing all internal components, including controls, instruments, wiring and labeling. Indicate panel installation locations in plan and elevation.
 - h. Submittal shall include manufacturer's cut sheet description, product Specification sheets and complete technical data, including:
 - 1) Denote with arrow, rectangle, highlighter or other PDF markup tool the specific part number used on mfr data sheets.
 - 2) Construction details, material descriptions, dimensions of individual components and profiles, and finishes
 - 3) Operating characteristics
 - 4) Electrical characteristics and power requirements
 - 5) Performance curves
 - 6) Operating range
 - 7) Accuracy and repeatability over range
 - 8) Control signal range
 - 9) Default condition upon loss of power
 - 10) Calibration data if applicable
 - 11) Environmental operating conditions and limits
 - 12) Furnished accessories
 - 13) Operation and maintenance instructions including factors effecting performance.
 - i. Submit on all required System Software Functions whether those functions are provided by a software application, a dedicated appliance, or are embedded in a controller.
 - 1) Note all deviations from this Section
 - 2) If product is a substitution, provide additional information
 - j. When manufacturer's cut-sheets apply to a product series rather than a specific product, the data specifically applicable to the Project shall be highlighted or clearly indicated by other means.
 - 1) General catalogs with no markup indicating specific part numbers used shall not be accepted as cut sheets to fulfill submittal requirements.
 - k. Format: Word-searchable format.
2. Shop Drawings
- a. Note: these documents are a roadmap for all future bldg. personnel decades from now. As such, DDC submittal especially needs to communicate routing of comm between major panels including but not limited to:
 - 1) AHU,
 - 2) IDF rooms
 - 3) Central Plant Equipment
 - 4) All terminal unit routers
 - 5) The path to the Front End and/or associated router.
 - b. This path tracing is to be performed for:
 - 1) All underground comm.
 - 2) Comm serving AHU, CUP, Yard Equipment
 - 3) All IDF FCU comm
 - 4) The building backbone comm between floor router panels terminal units and wireless receiver hubs.
 - 5) Comm in the pour
 - 6) All fiber routes provided specifically for DDC controls (not otherwise)
 - c. Note: terminal unit comm does not need to be shown in plan view. The standard schematic tracing of the VAVs will suffice. However, VAV numbers do need to be

correctly depicted in the correct node sequence for both comm and 24V power wiring. This is very important for TI work in the future and cannot be ignored.

- d. Denoting path for IO is not deemed critical except for:
 - 1) Remote DP sensors for AHU or hydronics, provide plan and elevation view if between floors.
 - 2) Remote flow meters for hydronics provide plan and elevation view if between floors.
 - 3) All meters and alarm points with wiring in the room such as grease traps, sump pumps, etc. plan view only.
 - 4) For all of these devices, DDC contractor to provide simple snippet from most relevant civil, electrical or other drawing with highlighted route showing schematically the path containing said wiring.
 - 5) If route is shown in the BIM model, provide plan view print out showing path.
- e. System architecture one-line diagram indicating schematic location of all control devices, workstations, LAN interface devices, gateways in addition to the following information:
- f. Network architecture of all panels in the building in schematic layout that clearly shows how all panels and controllers are linked.
- g. Schematic elevation view of building with panels and connections between floors:
 - 1) Data link of each LAN with physical characteristics and configuration.
 - 2) Each networked DDC device including location, service, device instance, MAC address and network number.
 - 3) Each IP networking device including location, service and IP address.
 - 4) Location of all interface devices including network interface jacks and workstation connections.
 - 5) Correct node sequence for power and wiring.
- h. Schematic flow diagram of each air and water system showing equipment and control devices. The schematics provided on Contract Drawings shall be the basis of the schematics with respect to layout and location of control points.
- i. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the Point Summary Table. Label each input and output with the appropriate range.
- j. Electrical schematic for each control panel and/or enclosure showing each point of connection and/or product requiring power with requirements (volts/amps/connection type) listed for each. Show all control power supplies including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
- k. Electrical wiring diagrams shall include ladder logic type diagram for motor starter, control, and safety circuits
- l. Electrical wiring diagrams shall include detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified.
- m. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- n. Wiring diagrams for all packaged equipment indicating all interconnecting wiring and termination of all wires including labels and point names.
- o. Wiring diagrams and schematics for each sensor.

J. Submittal Package 2 (Programming and Graphics)

K. Programming submittal

- 1. A detailed description of point naming convention to be used for all software and hardware points.
- 2. Submit Visual Logic for every controller for Owner and EOR to review. Screen captures are acceptable.

3. Submit any line code for all controllers.
4. As-builts of programming to be provided at the end of final commissioning to serve as record documents for future generations and warranty.
5. Control logic shall be annotated to describe how it accomplishes the sequence of operation.
6. Intended audience for comment are power-users with programming capabilities.
7. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
8. Example: simply naming a comment block "supply fan control" and another "CHW valve control" would provide sufficient annotation guidance.
9. Include Sequences of Operation with each control sequence.
10. Note any exceptions made, particularly if they were the result of final commissioning efforts that uncovered unforeseen issues.
11. All changes to SOO require review and approval of the Engineer of Record before 3rd party commissioning and approval by the Commissioning authority if made during commissioning. DDC Contractor is strongly encouraged to provide an informal pre-submittal of suggested or desired changes to control sequence logic.
12. Changes which are inconsistent with the intent of the SOO or may negatively impact energy consumption or occupant comfort are not acceptable and will be rejected.
13. Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters and limits.
14. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation.

L. Graphic screens submittal

1. Submit screen captures of graphic screens for review by owner to have input on subjective elements and inspect for conformity to standard conventions. Example: color of an alarm, red or yellow. Example: screen location of alarm, top right or bottom left.
2. DDC contractor is beholden to the contract documents for quantity of scope. Additional scope suggestions that arise as part of submittal review to be assessed on case by case basis as they could be outside the scope of this project.
3. If review process fails to capture graphic feature described in the contract documents, the scope must still be implemented.

1.08 COMPLETION REQUIREMENTS

- A. Documents. Provide in both paper and electronic format
- B. Operation and Maintenance (O&M) Manuals: In addition to items specified in Division 1 and Division 23, include the following:
 1. Include all approved submittals from EOR with any as-built changes (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual.
 2. Names, addresses, e-mail addresses and 24-hour telephone numbers of DDC Contractor and service representatives for DDC system and products.
 3. Operator's manual
 4. Digital copy database for all equipment at the time of commissioning sign off.
 5. Licenses, guarantees, and warranty documents for all equipment and systems, including the start and end date for each.
 6. Training materials
 7. Access Credentials: Provide usernames and passwords required to log into DDC System at all defined access levels (administrator, operator, etc.), as coordinated with Owner. Default passwords shall not be used.
 8. Commissioning Reports: Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc.
 9. Copy of inspection certificates provided by the local code authorities.

- C. Format of Completion Documents
 1. Access credential information shall be provided in hardcopy in a marked, sealed envelope directly to Owner, Owner's designated representative, building stationary engineer, or head of maintenance.
 2. Obtain signed receipt for transfer of credential information.

1.09 OWNERSHIP OF PROPRIETARY MATERIALS

- A. All Project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:
 1. Project graphic images
 2. Record drawings
 3. Project database
 4. Project-specific application programming code
 5. All trend and runtime data
 6. All reports prepared from DDC System trend or runtime data
 7. All documentation

1.10 WARRANTY

- A. The start of the warranty period will commence with the written acceptance of the system by the party who holds the contract of the DDC contractor. Note: this specifics of contract negotiations and or 3rd party commissioning are outside the scope of this specification, however the details of warranty are detailed below:
- B. Guarantee all materials, equipment, apparatus and workmanship (including original programming) to be free of defective materials and faulty workmanship for at least the following periods from date of acceptance:
 1. Controllers (BCs, AACs, and ASCs), routers and gateways: 1 year
 2. Valve and damper actuators: 1 year
 3. Sensors: 1 year
 4. Programming: 1 year
 5. Wiring and installation: 1 year
 6. All else: 1 year
- C. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. Contractor shall respond to the Owner's request for warranty service within 2 business days.
- D. In the first year of occupancy changes in use after commissioning sign off are to be expected and normal for any new construction project. It is the owner responsibility to respond and account for normal changes in weather, occupant use, and schedule with the following parameters:
 1. Setpoint changes do not constitute a warranty call for the DDC contractor. Setpoint adjustments for temp, cfm, gpm at the zone and equipment level to keep a building in spec are considered to be a normal part of owning a building. Similarly, adjusting them does not constitute waiver of warranty.
 2. Owner is not expected to make any visual logic changes to execute the sequence of operation.
 3. Owner is not expected to make any changes to PID loop tuning parameters such as K-factors that reside in the controller setting rather than at the front end. If hunting, overshooting or other such loop tuning inadequacy leading to instability or setpoints not being achieved is present, then this would constitute warranty issue for the DDC contractor.
 4. Equipment short cycling is a warranty issue for the BMS contractor. This is especially true for the major equipment: AHU, Chillers, CUP Pumps & Fans.
 5. Should a given piece of equipment not function as described in the sequence of operation through setpoint adjustment, such error is considered a warranty issue.

6. Should the owner choose to change programming logic or the sequence of operation, this constitutes a waiver in warranty and the owner proceeds at risk. Differences between DDC contractor backup and present logic will determine if changes exist.
 7. Equipment run in hand is done so at risk. Example: pump set to run with no feedback.
 8. Equipment may be digitally placed in hand are done so at risk. This can occur in the following ways:
 - a. Setpoints manipulated grossly out of useful range are essentially in hand. Example: AHU air pressure set to 4 in water column.
 - b. Placing equipment in service mode.
 9. Troubleshooting is not the same as warranty. The presence of an undesirable symptom could simply mean a setpoint needs to be adjusted. (Example, if there is a hot call, is the thermostat too high?) Owner facility staff to provide first response to address symptoms. Should issues persist, authenticity of warranty claims to be provided with reviewable, documented evidence such as trends, screen captures, photos, etc.
 10. Seasonal adjustments are not considered a basis for warranty. Equipment adjustments for changes weather are a normal part of building operation.
 11. Optimization efforts are not considered a basis for warranty. The sequences provided in this project will provide service to the building, but only a devoted study with several even dozens of seasons of data can provide optimization. Said additional efforts are not considered warranty nor are they part of the scope of this project. Examples of such include: trying to pursue the minimum possible Kw/ton, energy use intensity, flow rates.
 12. Equipment performing within the tolerances of this specification and/or have been determined satisfactory by the commissioning agent are to be considered functional. Controlling with any additional fidelity or precision is considered fine tuning and is outside the scope of this project. Such efforts would not be subject to warranty coverage.
- E. Operator workstation software: DDC contractor to provide corrections to errors that are demonstrated with trends or screen captures to not conform to the written contract documents.
- F. Front End version releases/updates of system software nor the installation/programming thereof are not covered by warranty requirement.
- G. Sequence of operation programming bugs (both due to programming misinterpretations and sequence errors) shall be corrected and any reasonable control sequence changes required to provide proper system operation shall be provided at no additional cost to the Owner during the programming warranty period. Warranty claim to be substantiated by written documentation
- H. Documentation: Record drawings and software documentation shall be updated as required to reflect any and all changes made to the system or programming during the warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the requirements of this Specification, provide products by one of the following manufacturers (listed in alphabetical order):
 1. Delta Controls
 2. Or equal with written approval from EOR prior to bid.
 3. Note: EOR is under no circumstances compelled to approve requests for alternate manufacturers as part of submittal process post bid. Such last-minute changes are highly discouraged, and contractor proceeds at full risk for bidding irresponsibly without prior written approval.
 4. Non-networked system components specified herein (including sensors, valves, dampers, etc.) need not be manufactured by the above manufacturers.

- B. Delta Controls by Delta Controls Partners established within a 70 mi radius of the jobsite within the past three years.
 - 1. The Contractor shall use only products from the corresponding manufacturer and product line listed.
 - 2. The system shall connect to the existing Delta Controls System. New graphics shall be created at this server. The system shall be installed in to match the owners standards including installation methods, graphic screens, programming, alarms, and historical trending to match the existing Delta Control System installed by Environmental Systems, Inc.
 - 3. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (e.g., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.
- C. The DDC System product line selected shall be the most current and complete offering from the manufacturer and shall currently be actively manufactured and supported at the time that this Project is bid.
- D. Deviations from Specification
 - 1. DDC Contractor shall thoroughly review this specification and note all items which do not comply with the listed requirements.
 - 2. For each item not fully in compliance, DDC Contractor shall provide a brief narrative describing the discrepancy. Include for each item a reference to the applicable paragraph of this document.
 - 3. Document all deviations from this Section.
 - 4. In general, deviations which do not compromise the performance, efficiency, or interoperability goals of the Project will be permitted.
 - 5. All deviations must be documented at this time. Deviations discovered later in the Project process, particularly after installation has begun, shall not be accepted.
 - 6. Acceptance or rejection of deviations from the requirements of this Section is at the discretion of the Engineer of Record.
- E. DDC Contractor Feedback
 - 1. DDC Contractor may at their option provide comments and feedback about elements of this and other Division 25 Sections which are in his/her opinion onerous, adding unnecessary cost, or potentially reducing the quality or efficiency of the DDC System. Contractor is encouraged to suggest alternative solutions.
 - 2. Items so noted will be reviewed by the Engineer of Record. Suggestions which do not compromise the performance, efficiency or interoperability goals of the Project may be accepted by the Engineer of Record.
 - 3. Requests to allow networked devices or control systems that are not fully BACnet compliant will not be accepted.
 - 4. If Engineer of Record does not respond to feedback/suggestions, this shall not be taken as a sign of acceptance. Unless explicitly indicated in writing by Engineer of Record, DDC Contractor is responsible for meeting all requirements of this and related Sections, regardless of perceived difficulty or cost.
 - 5. Provide comments and feedback no later than Submittal Package 1.
- F. Substitutions
 - 1. Substitutions shall be considered only after an extensive function-by-function comparison, additional reference checks, and the approval of the Engineer of Record.
 - 2. If DDC Contractor wishes to provide product from a manufacturer not listed in this Part of the Section, submit the following information to support the product under consideration:
 - 3. Product details: Submit complete documentation of the product. Provide literature, cutsheets etc. that document the product's compliance with all relevant codes, standards,

certifications, and listings required per this Section. Provide explanations for any requirements which cannot be substantiated from product literature.

4. Comparison: Submit extensive and detailed comparison of the product relative to this Section. Submit a copy of the applicable portions of this Section, with a note or comment for each requirement, indicating whether the proposed product complies or suggesting why compliance with a particular requirement is not necessary or appropriate for the needs of the design and the Project.
5. References: Ten completed buildings that are comparable in size, principal occupancy, climate type, and system types which have successfully utilized the product.
6. All requested substitutions shall be submitted not later than Submittal Package 1.
7. DDC Contractor shall not supply or install any hardware or software that is a substitution relative to the basis of design without written approval from the Engineer of Record.

2.02 PERFORMANCE REQUIREMENTS

A. Environmental Conditions

1. All DDC System components provided under this Specification shall operate under ambient environmental conditions of 32°F to 122°F dry-bulb and 10% to 90% relative humidity, non-condensing as a minimum.
2. It is the DDC Contractor's responsibility to identify locations subject to more extreme conditions, particularly rooftop and outdoor installations, and provide products suitable for those locations.
3. Sensors and control elements shall be constructed of material suitable and rated for the media sensed under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location.
4. Noise Immunity: comm shall not flutter in the presence of electrical noise.

B. DDC System Speed

1. DDC contractor to make provisions for hardwiring critical sensors (such as remote DPs for AHU and CUP) prevent virtual point delays.
2. Trends have been relaxed to 5-15min intervals to alleviate un-due network traffic.
3. Design intent is for 5-10 sec refresh rates at the front end.
4. Ownness on the contractor is really to apply programming such that networks do not slow excessively. Additional hardware to address speed or perceived speed issues for unforeseeable conditions is outside the scope of this project.
5. The communication speed between the controllers, routers, and operator interface devices shall be sufficient to ensure fast system response time under all loading conditions, including during collection of specified trend data.
6. I/O Response Time
 - a. Object scan: All input points connected to DDC system shall update at least every five seconds for use by DDC controllers.
 - b. Object command: All devices shall begin to respond to an automatic (generated by software) command of a binary or analog object within 15 seconds.
 - c. Operator command: All devices shall begin to respond to a manual (generated by operator) command of a binary or analog object within 15 seconds.
 - d. Graphics Refresh: The maximum time between an operator's selection of a graphic and it completely painting the screen and updating at least 50 points shall be less than 15 seconds.
7. Alarm Response
 - a. The maximum time between a device going into alarm and the annunciation of the alarm shall not exceed 10 seconds for a Level 1 or Level 2 alarm, or 20 seconds for other alarms.
 - b. Each workstation on the DDC LAN shall receive alarms within 5 seconds of other workstations.
8. Processing Speed

- a. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every second. Contractor shall be responsible for selecting execution times consistent with the process under control.
- b. Control Loop Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this frequency.

C. Control Stability

- 1. Except as noted in Sequences of Operation, tune all control loops to obtain the fastest stable response without hunting, offset, or overshoot.
- 2. Control loops shall maintain each controlled variable at setpoint within the following tolerances:

Controlled Variable	Tolerance
Space Temperature (drybulb)	±1.5°F
Ducted Air Temperature (drybulb)	±2.0°F
Humidity	±5% RH
Duct Air Pressure	±0.1 in-wg
Building or Relief Plenum Air Pressure	±0.01 in-wg
Air Flow	±10%
Air Flow (pressurized spaces)	±5%
Hot Water Temperature	±3.0°F
Water Flow	±10%
Water Differential Pressure	±1.5 PSI
Other	±2 x accuracy

- 3. Control loop shall return its controlled variable to specified tolerances within 3 minutes of any disturbance (equipment startup excepted).

D. Network or Comm loss

- 1. Design intent is for piece of equipment to be able to operate through temporary network interruptions on the order of 60 min or less.
- 2. To the extent possible all logic, data and sensor inputs required to perform the specified Sequence of Operation for a given piece of equipment should be executed by a single controller dedicated to that equipment. Exceptions include: global points such as schedule, modes, weather, etc.

E. Overrides

- 1. Values for all points, including real (hardware) points and virtual (software) points used in Sequences of Operations shall be capable of being overridden by the user with appropriate access level.
- 2. Operator overrides shall remain in effect until they expire (timed overrides) or are released/cancelled (indefinite overrides). The DDC System shall not reset active overrides during a data scan/update.
- 3. The user's interface shall be designed to make it obvious when a point has been overridden.

F. Command Priority

- 1. The system shall observe the BACnet command priorities, including the following (from highest to lowest):

- a. (as applicable) Smoke Control and Life Safety (Priority Level 1 & 2).
 - b. Manual Operator Command (Priority Level 5 or 8).
 - c. Energy Management (Priority Level 9).
 - d. Normal Automatic Control (Priority Level 10 or greater).
2. Operator overrides shall have a higher command priority than automatic/programmed commands generated by the Sequence of Operations.
 3. The admin shall have a higher (i.e. more dominant) command priority than other users.

G. Alarms and Events

1. All events shall be generated at the control module level and shall record time and date from the originating local control module.
2. Alarm properties shall be defined using BACnet Event templates, including all the following information:
 - a. Name
 - b. Description
 - c. Alarm level
 - d. Whether acknowledgement is required
 - e. Whether alarm can clear automatically (i.e. whether acknowledgement of return to normal operation required)
 - f. Event reporting action
3. Event Reporting Actions shall be configurable to automatically respond to any individual alarm/event or any alarm/event category. At least the following actions shall be supported:
 - a. Display a message (the event message or another predefined message, including images) in a pop-up window at the graphical interface
 - b. Save/export message to a text file
 - c. Run an external program or routine
 - d. Write property to any BACnet device, allowing alarm to change equipment operating mode
 - e. Generate an audible annunciation at the operator's workstation
 - f. Notify operators by email if desired
4. System shall support custom lists of individuals to be notified for any individual alarm/event or any alarm/event category.

2.03 SYSTEM ARCHITECTURE

A. General

1. The network architecture shall be an all ethernet DDC control system.
2. Use of MS/TP for terminal unit controllers is not acceptable as these are expected to obsolete and phased out within the next 1-2 years. All major manufacturers of DDC have Ethernet alternatives available, these must be used.
3. Only where mechanical equipment manufacturers do not offer BACnet IP devices, will an MSTP integration be acceptable.
4. DDC contractor is responsible to use any routers, repeaters or other network equipment necessary to accommodate distances.
5. 120V will be available in the electrical and IDF rooms. The DDC contractor may not assume that 120V will be provided in any other locations unless specifically called for on the mechanical & electrical plans. DDC contractor is therefore responsible for providing 24V power or power over ethernet to all controllers, sensors, actuators, end devices for a complete and working system.
6. The building network architecture must have trunks with dedicated ethernet routers so that all controllers on a given trunk that may be isolated without necessitating shut down of the other trunks. Minimum division of trunks should be provided for but not limited to:
 - a. Roof equipment
 - b. Central plant equipment
 - c. All owner controlled IDF room FCUs

- d. Every floor of terminal units served by common parent equipment. (see details below)
 - e. Note: electrical rooms that do not have computer servers or other equipment that will fail if hot are not included in the IDF requirement.
7. At a minimum, DDC network trunks for terminal units on every floor must follow the following guidelines:
- a. There must be an ethernet router panel per AHU serving that floor. Example: if the floor is served by 2 AHU, then there must be 2 router panels on each floor.
 - b. All terminal units served by a single AHU must be no the same Ethernet trunk together. Running a single trunk for a floor and using a digital aggregation method is not acceptable.
 - c. Where multiple office tenants on a single floor are served by the same AHU, no further subdivision is necessary. However, using an Ethernet ring configuration which ties the farthest controller back to the source router is required so that a potential disruption in comm for one tenant does not lead to discontinuity for the other tenant.
 - d. All floor router panels to reside in IDF or electrical rooms with secure lock and key for owner access only. Locating these above ceilings or in hallways is not acceptable.
8. Food and beverage tenants must have their own Ethernet router and dedicated trunk.
9. The backbone for each building will then be provided with a global controller or supervisor level controller that manages the building as a whole and all trunks it is connected to. This will be the single point of connection to the campus front end.
10. Each building and all subsystems therein must be able to operate independently if a connection to the campus front end is temporarily lost.
11. IDF rooms will be on a dedicated ethernet trunk that may operate or be isolated independently from the rest of the building.
12. Tennant Billing provisions:
- a. Food and Beverage tenants will require the following meters on the Owner system for utility consumption:
 - b. Hydronic Btu consumption. Units: rate and consumption using same units as central plant controllers. Provide conversion to % of total central electrical consumption for tenant billing.
 - c. Total Electrical, no sub-divisions. Units: kW, kWh
 - d. Total Gas, no sub divisions. Therms
 - e. Total Potable Water, no sub-divisions. Units: gpm, kilogallons.
 - f. Total Purple Water, no sub-divisions. Units: gpm, kilogallons
 - g. Potential for unit discrepancy exists, defer to local utility requirements if discrepancy exists)
13. Office tenants sub-metering:
- a. For instances where a separate, revenue grade electric meter has not been provided, the BMS will calculate % consumption of the total measured from the associated revenue grade meter.
 - b. House HVAC consumption:
 - 1) House air to be a calculated value based on CFM measured by the VAV. Sum the cfm VAVs from every tenant to arrive at the consumed fraction of the AHU production. Example: if 50kcfm are used by a tennant from and AHU producing 200kcfm, then their fraction of house air is $200/50 = 25\%$ of the total HVAC electricity.
 - 2) IDF rooms and associated HVAC loads will not be subdivided. These are considered to be part of pug load.
 - 3) Hydronic consumption from the plant is measured based on Belimo Energy valve at the AHU (as applicable) or
 - 4) fraction of the whole HVAC energy consumption.

- c. Potable water to be a calculated value per the owner lease agreement. No submeter is deemed necessary as consumption is very low.
 - d. Btu meters for office tenants are not deemed necessary.
 - e. Lighting integration for kW and kWh data is acceptable.
14. The system shall be configured as a distributed processing internetwork capable of expansion as specified herein.
 15. All control products provided for this Project shall comprise an interoperable Native BACnet System. All control products provided for this Project shall conform to ASHRAE Standard 135.
 16. Provide hardware and software resources sufficient to meet the functional requirements specified in this Section. Include all items not specifically described in this Section that are necessary to implement, maintain, and operate the system in compliance with the functional intent of this Specification.

B. Networking Practices

1. The ASHRAE 135 BACnet communication protocol shall be sole and native networking protocol used throughout entire DDC system. Only native BACnet control devices shall be used without explicit written permission by the Engineer of Record.
2. Communication gateways, bridges, protocol translators or any other device that translates any proprietary communication protocol to BACnet are not acceptable as a part of the Work under this Section, with specific exceptions.
3. DDC System shall communicate via a dedicated control internetwork that is not shared with other building systems or tenant data and communication networks.
4. The Owner's IT network shall not be used for control purposes.
5. Any use of Owner's IT infrastructure requires written permission from Owner. DDC Contractor shall coordinate with Owner and Owner's IT staff before time of bid.
6. Wireless communication in any control LAN not a generally accepted practice. Very unique instances where wiring is not possible could potentially exist but are rarely more than 1% of the project. These instances are typically retrofit situations, historical buildings with delicate architectural finishes, or where an array of sensor fields is combined with hardware backup points.
7. For the purposes of this document, wireless communication is between sensor and controller, not controller to controller unless specifically called for in the EOR provided dwgs or EOR provided network architecture.
8. Where wireless forms of communication are explicitly shown on the dwgs the contractor must adhere to the correct type of wireless technology called for in the drawings and sensor specifications.
9. There are many types of wireless communication, not all possess the same capabilities and none have universal application. Example: EnOcean is not to be confused with Zigbee is not to be confused with BlueTooth is not to be confused WiFi is not to be confused with 5g cellular. Contractor must use the type explicitly called for and apply it as intended.

C. Network Hierarchy:

1. A Supervisory Control Network may be used to connect building controllers, servers and operator workstations.
 - a. Supervisory Network may be a Local Area Network, or it may span multiple buildings or locations as a Wide Area Network (WAN).
 - b. Supervisory Network link layer shall be Ethernet (IEEE802.3).
 - c. Supervisory Network networking layer shall be BACnet/IP and shall share a common network number for the Ethernet backbone, as defined in ASHRAE Standard 135.
 - d. Supervisory Network, including all routers and switches, shall support no less than 100 Mbps.
 - e. Powerline communications is not acceptable.

2. A Primary Control LAN shall connect advanced application controllers to building controllers and to other advanced application controllers. The Primary LAN communicates exclusively control information.
 - a. Each Primary LAN shall be contained within a single building. A single Primary LAN shall not span multiple buildings.
 - b. Primary LAN link layer shall be Ethernet (IEEE802.3).
 - c. Primary LAN networking layer shall be BACnet/IP or BACnet Ethernet as defined in ASHRAE Standard 135.
 - d. Primary LAN, including all routers and switches, shall support no less than 100 Mbps.
 - e. Powerline communications is not acceptable.
3. Secondary Control LANs shall connect application specific controllers to other application specific controllers and to terminal control devices such as networked thermostats. Each Secondary Control LAN shall connect to a Primary Control LAN via a BACnet IP router.
 - a. Each Secondary LAN shall be contained within a single building. A single Secondary LAN shall not span multiple buildings.
 - b. Secondary LAN link layer shall be Ethernet (IEEE802.3).
4. The network architecture, and number and type of LANs shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all DDC System networks.
5. To the extent feasible, Secondary Control LANs shall be configured so that the control network architecture parallels the mechanical system architecture. For example, a Secondary LAN of VAV controllers should connect directly to the advanced application controller or building controller which controls the air handler that serves the VAV boxes.

D. Operator Means of Access

1. DDC Contractor shall configure hardware and software to support the following means of access to the DDC System:
 - a. Desktop or portable computer
 - b. Any supported browser using remote access to Owner's IT network, and/or via internet connection and Owner's VPN tunnel
 - c. Mobile computing device ("smart" phones, tablets, etc.) using app or browser.
2. DDC System shall be able to accommodate at minimum five simultaneous operators that are accessing DDC system through any of the means indicated, without impacting performance.

2.04 SYSTEM SOFTWARE FUNCTIONS

- A. DDC contractor to use dealer license to achieve all intermediate project goals necessary. Waiting until the final front end can be placed is no excuse for keeping pace with the project schedule.
- B. General
 1. All System Software functions shall be hosted on one or more of the following platforms. Different functions may be hosted on different platforms, as dictated by system design and control products selection.
 - a. Running as application software on the Data Archive Server, if one is present or provided.
 - b. Embedded in a BACnet Building Controller (B-BC)
 - c. Embedded in a BACnet control device dedicated to the purpose
 - d. The Advanced Workstation (B-AWS) interface may also be installed on portable computers.
 2. The device(s) hosting the System Software shall reside on the Supervisory Network if one is present or provided, or on the Primary Control LAN otherwise. Communication shall be BACnet/IP.

3. Devices hosting System Software shall be always on and always connected to the control internetwork.
 4. All System Software functions shall be provided by native BACnet applications or devices. In each case, the BACnet operating stack must be embedded in the application core.
 5. Security shall be multilayered, supporting at least five access levels with unique credentials for each user.
 6. User Interface
- C. Operator's Web Interface / Front End Software (OWI)
1. The Operator's Web Interface (OWI) provides day-to-day monitoring and basic operation of the DDC System and BACnet internetworks through a web browser interface.
 2. The OWI shall allow the operator to access graphics, point displays, and trends, to create exception schedules, and to perform overrides of variables or points displayed on the control graphics.
 3. The OWI is not required to provide for configuration or programming of the DDC System.
 4. The OWI shall be based on server/thin-client architecture, designed around open standards of Web technology and HTML 5 graphics, which provides operators with complete supervisory access to the DDC System via a web browser. No Java plugins, ActiveX components, or any special software other than a web browser shall be required to access the full functionality described in this Paragraph. The current versions of the following standard web browsers shall be supported at a minimum:
 - a. Apple Safari
 - b. Google Chrome
 - c. Microsoft Edge
 - d. Microsoft Internet Explorer
 - e. Mozilla Firefox
- D. User Interface
1. With the proper credentials the operator shall be able to manually adjust all data point values (hardware or software) in the system, alter or lock control loop output values, set schedules, and command points to manual override, timed override and automatic mode.
 2. All graphical interface objects including animations shall be stored in the DDC System. Applications shall not require system graphics to be pre-loaded on the client browser.
 3. Operators shall have the ability to dynamically create messages associated with individual objects in any information window/view or associated to the window/view itself. These messages are persistent until erased and may be viewed and modified by other operators during other sessions.
- E. Alarm/Event Processing
1. The OWI shall display and log events from any BACnet object in the system and shall support operator configuration of alarm limits, differentials, states and reactions.
 - a. The operator shall be able to view all current and past alarms/events from any location in the internetwork.
 - b. With the proper credentials, an operator shall be able to acknowledge and clear alarms.
- F. Scheduling
1. The interface shall support viewing existing schedules.
 2. A properly-credentialed operator shall be able to create exception schedules from the daily, weekly, or monthly views.
- G. Trend Logs
1. OWI shall support the viewing and manipulation of trend data. Trend log creation/setup is not a required feature for the OWI.
 2. The interface shall be able to display trend data as timeseries graphs (i.e. two-axis (x, y) graphs that simultaneously display values relative to time).

3. Graph shall be able to display at least eight objects in different colors, even if objects have been trended at different time intervals.
 4. Where trended values are COV, software shall automatically fill the trend samples between COV entries.
 5. A graph legend shall identify each variable plotted.
 6. Multiple scales shall be possible, one for each object, with range set automatically by the software but capable of being manually adjusted by the operator.
 7. Data shall be able to dynamically update at operator-defined intervals, including on a 1 second interval for loop tuning.
 8. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and pan through historical data by simply scrolling the mouse.
 9. It shall be possible to pick (or float mouse over) any sample on a trend and have the numerical value displayed.
 10. These capabilities shall be intrinsic to the interface and shall not require the download of data to a separate application.
 11. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard Windows keystrokes.
 12. Trend log data shall be able to be exported as tables in CSV or XLS formats. Interface shall be able to export at least 25 trends to a single file; solutions which require exporting each trend one at a time shall not be accepted.
 13. Graphical representations of trend data log data shall be able to be saved/exported as an image file in a common format (JPG, PNG, GIF, or TIFF).
 14. Trend log data stored on controllers and data stored on the Archive Server (if any) shall be integrated seamlessly, in the same table or graph, without additional effort from the operator.
- H. Runtime Logging and Totalization
1. The system shall provide runtime totalization for every binary object in the system which indicates the operation of equipment.
 2. The operator shall be able to create, view, and reset runtime logs via the interface.
 3. Runtime data shall be stored locally in the BACnet device which holds the binary object, using standard BACnet objects and properties.
 4. Runtime logs shall record total accumulated active time and total accumulated active transitions since last reset. Logs shall also record the timestamp and state for the last 100 transitions on a rolling basis.
 5. Runtime data shall be preserved until reset by the operator. It shall not be overwritten, nor shall it be archived.
- I. Provide an audit trail feature that automatically records the date, time, user, and action associated with all user access and changes to the DDC System.
- J. Internet Access
1. The DDC front end shall be “ready to connect”, however all firewall, security and IT requirements are on the owner.
 2. DDC Contractor shall coordinate with Owner’s IT department.
 3. The OWI host device shall be configured to be always connected.
 4. All communication on the IT LAN/WAN or the Internet shall utilize Secure Socket Layer (SSL) or Transport Layer Security (TLS) technology.
 5. Proper credentials shall be required in order to log into OWI regardless of means of connection.
- K. BACnet Advanced Workstation (B-AWS)
1. The BACnet Advanced Workstation (B-AWS) provides for the complete configuration, monitoring, modification, programming and operation of the entire DDC System.
 2. The Advanced Workstation shall:

- a. Comply with the minimum requirements of ASHRAE Standard 135 Annex L for a B-AWS and shall be certified and listed by the BACnet Testing Laboratories (BTL) as a B-AWS prior to the bid date for this Project.
 - b. Meet all requirements and provide all functions
 - c. Meet all the requirements and provide all functions except as follows:
 - d. The B-AWS may be a client-based application is not required to follow the thin client model or support access via web browser as described
 - e. The Internet Access/Web Server capabilities and connection are not required.
 - f. Meet all requirements and provide all functions described in this.
3. DDC System Configuration and Programming Capabilities
- a. The B-AWS shall provide a complete engineering tool for the configuration of the system, allowing a properly-credentialed user to create, delete or modify any configuration parameter, program, graphic, trend log, alarm, schedule or BACnet object in the DDC System.
 - b. The B-AWS shall provide a complete programming environment for the creation and modification of control logic algorithms using graphics (wire sheet), text (line code) or some combination.
 - c. Provide a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of Sequences of Operations. Include at least the following:
 - d. Proportional (P-only), proportional-integral (PI), and proportional-integral-derivative (PID) control loops.
 - e. Software tools for tuning control loops and adjusting gains.
 - f. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time-of-day, high-signal select, low-signal select.
 - g. Standard logic operators such as AND, OR, NOT, and XOR (exclusive OR).
 - h. Operators for basic arithmetic
 - i. Relational operators such as is-equal, not-equal, greater-than and less-than
 - j. Operators for square root, raise to a power (i.e. xy), log, natural log, absolute value, and minimum/maximum value from a list
 - k. Basic trigonometric operators such as sine, cosine, and tangent
 - l. Psychrometric parameters: calculation of wetbulb, dewpoint, and enthalpy from drybulb temperature and relative humidity.
 - m. Include a search capability that will search all control sequences for a given point name to determine all sequences that use or control the point.
4. Groups
- a. The user shall be able to assign BACnet objects, parameters or points to groups manually, by type, or using wildcard search.
 - b. A properly-credentialed user shall be able to apply batch modifications or overrides to an entire group with a single action.
 - c. A single object or point may belong to more than one group. If multiple overrides conflict on a single object, the one with the highest assigned priority shall prevail.
5. Security
- a. Authorized users shall have the ability to configure credentials for all other operators.
6. User Interface
- a. In addition to the other override capabilities described above, a user with proper credentials shall be able to
 - 1) Manually adjust control loop tuning parameters (gains) and employ loop tuning tools.
 - 2) Apply overrides (manual, timed, or return to automatic operation) to all members of a defined group of BACnet objects
 - 3) View a list or generate a report of all points and objects currently in override.
 - 4) Globally release (i.e. return to automatic operation) all overridden points and objects.

- 5) View and modify the status and present value of any BACnet object or property in the DDC System, including all real and virtual input and output points.
 - b. A properly-credentialed user shall be able to create, edit, install and remove control programming from any device on the DDC system.
 - c. A properly-credentialed user shall be able to
 - 1) Create new and edit existing graphical pages, views and displays, including read-only web pages served by the OWI (if applicable).
 - 2) Link graphical interface pages to DDC points, objects and control logic to create new dynamic control interfaces which are available through the OWI.
 - 1.A.1.a.1.i.1. Graphic images may reside anywhere on the DDC System; however, all dynamic data and attributes must reside in its associated controller or device.
 - d. B-AWS software shall support at a minimum BMP, GIF, TIF, JPG, EMF, PNG, SWF and DIB graphic file formats and allow for the use of custom animation objects and URL hyperlinks.
7. Scheduling
- a. The B-AWS shall allow properly-credentialed users to create, delete, modify and view binary, analog and multistate BACnet Schedule objects and parameters.
 - b. All capabilities of the interface shall be available.
8. Trend Logs
- a. The B-AWS shall support creation of custom trends for any object in the system.
 - 1) Trends shall be created using the BACnet Trend Log and BACnet Trend Log Multiple objects.
 - 2) Trends may be created with any sampling frequency or Change of Value (COV) threshold.
 - 3) Trends may be active indefinitely or defined with specific start and end times.
 - b. Trend data shall be sampled and initially stored locally in the BACnet device which holds the object being trended. No additional server or device shall be required for collection or short-term storage of trend data.
 - c. All trend log display, visualization and export functions supported by the Operator's Web Interface shall also be available through B-AWS.
9. System Diagnostics: Provide fully automatic verification of internetwork communication with automatic alarming in the event of communications failure.
10. DDC System Configuration/Programming Backup and Restore
- a. The B-AWS shall allow a properly-credentialed user to backup, restore and/or clear configuration data and control programming from any device on the DDC System internetwork.
 - b. The B-AWS shall be able to perform automated network backup of configuration, control programming and graphics in all devices on the DDC System internetwork according to operator configurable schedule and storage directory structure.
 - c. If Data Archive Server is provided, the DDC Contractor shall configure automatic backup of the DDC System configuration, programming and graphics once per week or as requested by building maintenance staff. Configure system to retain at least last four backups.

2.05 HARDWARE DEVICES FOR OPERATOR'S INTERFACE

- A. Operator Workstation. Not needed, interface with Existing PC-based system.
- B. System Graphics. The existing operator workstation software shall be expanded to include new graphics to match the remodeled systems.

2.06 DATA ARCHIVE SERVER

- A. DDC Contractor will provide server hardware and software as required to support the trends specified in this project.

2.07 NETWORK COMMUNICATION DEVICES

- A. General
 - 1. These shall be microprocessor-based communication devices providing data routing, protocol translation, and/or message transmission on the DDC internetwork as described below.
 - 2. Devices may be independent or may be embedded within a DDC controller.
 - 3. Each independent device (i.e. not embedded within a controller) shall have its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply.
 - 4. Device memory shall be protected in the event of a power failure
- B. BACnet Broadcast Message Routing
 - 1. DDC System shall support the ability for a common BBMD Broadcast Distribution Table (BDT) to be configured once and then sent to all BBMDs.
 - 2. The DDC Contractor shall provide a spreadsheet documenting the following information, which shall be included with Closeout documents
 - a. The identity, physical location and network address of all BBMD in the control system.
 - b. The broadcast distribution table for each BBMD.
- C. BACnet Gateways and Network Devices
 - 1. In general, any equipment that the DDC needs to be integrated to must be purchased with a BACnet gateway that the DDC system can connect to. Purchasing responsibility is on the division providing that equipment not the Div 25 contractor.
 - 2. IO is the preferred control method, integration is preferred for monitoring points that cannot be gathered with IO.
 - 3. Integration to the following equipment is required at a minimum:
 - a. Heat Pumps
 - b. VRF equipment
 - 4. Gateways shall be able to
 - a. Read and view all readable object properties from non-BACnet network to BACnet network and vice versa, using standard BACnet services.
 - b. Write to all writeable object properties to non-BACnet network from BACnet network and vice versa, using standard BACnet services.
 - 5. For each gateway, provide an interoperability schedule showing each point or event on legacy side that BACnet network will read, and each parameter that BACnet network will write to.
- D. Wireless Networking and Communications
 - 1. Wireless networking and communications devices shall not be used in the DDC System BACnet control internetwork without specific written permission from the Engineer of Record.
 - 2. No portion of the trunk of the Supervisory Network, Primary LAN or Secondary LAN may rely on a wireless data link without written permission from the EOR.
 - 3. Wireless space temperature sensors are permitted for the use of creating additional feedback points for complex zones such as wide-open spaces subject to multiple inflicting factors are present or in tall stratified ceilings where wiring costs are prohibitive. However, at least one wired space temperature sensor is required for zone feedback. Exceptions will be considered on case by case basis in writing by EOR.

2.08 DDC CONTROLLERS

- A. General

1. DDC controllers shall perform monitoring, logging and control functions as specified. All specified controller functions shall be resident in the controller.
- B. Control Loops
1. All DDC controllers shall support at minimum
 - a. Two-position (on/off) control
 - b. Proportional-only control
 - c. Proportional plus integral (PI) control
 - d. Proportional-integral-derivative (PID) control
 2. Control loop algorithms shall be an intrinsic function, requiring no additional programming or hardware.
 3. Both direct- or reverse-acting control loops shall be supported.
 4. Control loops shall incorporate anti-windup technology or software.
 5. All control loop gains shall be independently adjustable.
 6. DDC System shall be provided with loop tuning tools for calculation of proportional, integral, and derivative gains for stable control loop operation. Loop tuning tools provided with the BACnet Advanced Workstation software is acceptable.
- C. Programmability: All controllers shall be fully programmable and support custom control strategies, programs and databases that are completely modifiable over the BACnet internetwork once installed.
1. All controllers delivered as a part of this Specification shall be programmed using a single common programming language, means and method via the operator's interface. Devices that require specific custom applications for configuration shall not be acceptable.
 2. Control programming shall employ the BACnet protocols for Standard Command Priorities.
 3. The controller must be capable of supporting software (virtual) points to be used in Sequences of Operations, monitored and overridden just as if they were real digital or analog points.
 4. The user shall be able to add, delete, or modify objects in real time without taking the controller offline or impacting the operation of the controlled equipment.
 5. Programming shall provide all the necessary mathematics, logic, utility and control functions necessary to execute the specified sequence of control.
- D. Communication
1. Data shall be shared between networked controllers and other network devices. Point information from any controller (including BCs, AACs, and ASCs) and from any gateway shall be capable of being used in a control sequence in any other panel.
 2. Communication software shall include error detection, correction and re-transmission to ensure data integrity.
 3. Each controller shall be capable of locally executing global strategies for the DDC System based on information from any object in the internetwork. Control systems that require a higher-level host processor for update, time stamps, global point data, COV transfer, online control instruction, or communications control between panels is not be acceptable.
- E. Input and Output Point Interface
1. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
 2. Input and output points shall be protected from voltage up to 24 V (AC or DC) of any duration so that contact will not damage controller.
 3. Each output point shall have a programmable signal value which is output in the event of a failure. The controller shall transmit and maintain this failure signal in the event of a system malfunction as long as power is available at the controller. This failure signal shall be determined on a per point basis.
 4. Analog Inputs (AI) points:
 - a. AIs shall include monitoring of low-voltage (0-10 VDC or 0-5 VDC), current (4 - 20 mA) and resistance signals from thermistor and RTD sensors.

- b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
 - c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution based on the type of controller (specified in subsequent Sections) or as required to comply with specified accuracy requirements.
- 5. Analog Output (AO) points:
 - a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution based on the type of controller (specified in subsequent Sections) or as required to comply with specified accuracy requirements.
 - b. Output signals shall have a range of 4-20 mA or 0-5 VDC or 0-10 VDC as required for proper control of output device. Pulse-width modulated (PWM) analog signals are not acceptable.
 - c. Each point shall be capable of being individually calibrated for zero and span.
 - d. AOs shall not exhibit a drift of greater than 0.4% of range per year.
- 6. Binary Input (BI) points:
 - a. Controller BIs shall accept contact closures or pulses
 - b. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
- 7. Binary Output (BO) points:
 - a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
 - b. Each point shall be configurable as normally open or normally closed.
- 8. Universal Input (UI) points:
 - a. Shall incorporate all of the features of BI points and AI points.
- 9. Universal Output (UO) points:
 - a. Shall incorporate all of the features of BO points and AO points.
- F. Scheduling: All controllers shall support the standard BACnet Schedule and BACnet Calendar objects
 - 1. Schedule objects shall reside in each individual device. Scheduling that requires an ongoing active connection to a workstation or server shall not be acceptable.
 - 2. BACnet Schedule objects shall support binary, analog, and multi-state values.
 - 3. BACnet Schedule objects shall be able to directly command any BACnet object in the internetwork without requiring custom programming.
- G. Time Synchronization
 - 1. Operators shall be able to set the time and date in any device on the network that has a real-time clock.
 - 2. The operator shall be able to set the time and date for an individual device (for override/testing purposes) or for all devices simultaneously.
 - 3. Automatic time synchronization shall be provided using BACnet services.
- H. Timed Override
 - 1. All controllers shall support operator-initiated timed overrides of hardware and software objects with user-configurable override periods. When the override period has expired, the controller shall automatically return the object to the automatic state without any additional action on the part of the Operator.
 - 2. The timed override functionality shall exist entirely in the controller. A workstation shall not be required for the execution of the time period nor for returning the object to automatic.
- I. Memory: Each controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 1. Configuration and software shall be retained (retention of locally-stored trend data is not required) in the event of a power outage without requiring a download from higher level controllers by one or more of the following means:

- a. Volatile RAM shall have a replaceable battery backup using a battery
- b. Volatile RAM shall have an automatically rechargeable battery backup using a battery
- c. EEPROM, EPROM, or NVROM non-volatile memory.

J. Trend Logs

1. All controllers shall be able to store trend data locally; network connections shall not be required for trending to occur.
 - a. Provide sufficient memory to record the specified number of records (data value and time of occurrence) for each hardware point on the controller (counting every point, not just points currently in use) and an equal number of software points.
 - b. Local storage shall be sufficient to record at least one week of data at a 5-minute interval for every required point.
 - 1) Exception: Application-specific controllers shall have sufficient capacity to record at least one day (24 hours) of data.
 - c. Battery-backed or nonvolatile memory is not required for trend storage.
2. At each controller, newly acquired trend data shall overwrite the oldest trend data so as to preserve the longest possible contiguous data set in local storage.

K. Alarm Processing: Controller software shall support alarm/message processing

L. Software Updates and Downloads

1. Operating System Firmware:
 - a. All controllers shall permit operating system firmware updates at any time after installation, utilizing the BACnet network.
 - b. Operating system firmware that requires chip replacement or flash modification is not acceptable.
2. Application Software:
 - a. It shall be possible to upload or download site-specific programming (control logic, graphics, schedules, etc.) to/from any controller via direct connection or over the network.
 - b. It shall be possible to initiate uploads and downloads manually, via schedule or automatically upon detection of loss or change of programming.

M. Communicating Sensors: All controllers shall support and be capable of monitoring and controlling a network of communicating space sensors without consuming physical hardware input/output points on the device.

N. Self-Test and Failure Response

1. Each controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Cease operation
 - b. Place each point in a predetermined failure state
 - c. Generate an alarm notification
2. Each controller shall be able to detect a loss of connection to its LAN(s). In that event
 - a. Controller shall store the loss of communication alarm along with the time of event, for transmission when network connection is restored.
 - b. All control functions shall continue based on last known values or a programmable fail-state value.

O. Loss of Power

1. Upon a loss of power, all software, database parameters and data (except locally-stored trend data) shall be protected from memory loss as described in this specification.
2. When power is restored, controllers shall automatically resume function as described

2.09 BUILDING CONTROLLERS

- A. Provide an adequate number of Building Controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these panels shall meet the following requirements.
1. The Energy Management and Control System shall be comprised of one or more independent, standalone, microprocessor-based Building Controllers to manage the global strategies described in the System Software section.
 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. Data shall be shared between networked Building Controllers.
 4. The operating system of the Building Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms.
 5. Controllers that perform scheduling shall have a real-time clock.
 6. The Building Controller shall communicate with other BACnet objects on the internetwork using the Read (Execute and Initiate) and Write (Execute and Initiate) Property services as defined in ASHRAE Standard 135-2020.
 7. BACnet Functional Groups. The Building Controller shall support the following BACnet functional groups: Clock, Event Initiation, COV Event Response, Files, Device Communication and Time Master.
- B. Communication
1. Each Building Controller shall support BACnet™ over Ethernet and BACnet™ over IP. The Building Controller shall be connected to the BACnet network using the ISO 8802-3 (Ethernet) Data L/ Physical layer protocol.
 2. Each Building Controller with a communications card shall perform BACnet routing if connected to a network of Custom Application and Application Specific Controllers.
 3. The Building Controller secondary communication network shall support BACnet MS/TP.
- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 40°C [32°F to 100°F] and 10 to 90% RH.
 2. Controllers used in conditioned space shall be mounted in dust proof enclosures and shall be rated for operation at 0°C to 50°C [32°F to 120°F].
- D. Building Controllers shall be fully peer to peer.
- E. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field- removable, modular terminal strips.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. The Building Controller shall maintain all database information including BIOS and programming information in the event of a power loss for at least 72 hours. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft].
- G. Inputs/Outputs.
1. Inputs. Controller input/output board shall support dry contact, 0-5 VDC and 0-10 VDC-voltage, 4-20 mA- current and thermistor-resistive signal types (10K ohm) on an individual basis for connecting any status or sensing device.
 2. Outputs. Output supported shall be 0-10 VDC, 24 VAC triac, 24 VAC dry contact. All HOA's shall be supervised.
 3. Diagnostics. Controller input/output board shall have red LEDs providing input status indication.

4. Building Controller shall have the capability to create, delete and support the following BACnet Objects:
- a. ANALOG INPUT, ANALOG OUTPUT AND ANALOG VALUE: These objects shall have the following writeable properties: Object Name; Object Value; Description; COV Increment; Out of Service and Units. In addition, these objects shall support the properties: Device type; Reliability; Min./Max. Values; Update Interval and Resolution.
 - b. BINARY INPUT, BINARY OUTPUT AND BINARY VALUE: These objects shall have the following writeable properties: Object Name; Object Value; Description; Polarity; Default Value; Min On/Off and Out of Service. In addition, these objects shall support the properties: Device Type; Reliability; Active/Inactive Texts; Update Interval; Resolution; Change-of-State Time; Count Times and Time Reset.
 - c. CALENDAR: This object shall have the following writeable properties: Object Name; Object Value; Description; and Date List.
 - d. DEVICE: This object shall have the following writeable properties: Object Name; Description; Location; and UTC Offset.
 - e. EVENT ENROLMENT: This object shall have the following writeable properties: Object Name; Object Value; Description; Out-of-Service; Event & Notify Types; Parameters; Property Ref; Enable; and Notification Class.
 - f. FILE: This object shall have the following writeable properties: Object Name; Description; File Type; and File Access.
 - g. LOOP (PID): This object shall have the following writeable properties: Object Name; Object Value; Description; Polarity; Output and Input Refs.; Input Value & Units; Setpoint Value; PID Values; Bias; Write Priority and COV Increment. In addition, this object shall support the properties: Reliability; Update Interval; Proportional Constant & Units; Derivative Constant & Units.
 - h. NOTIFICATION CLASS: This object shall have the following writeable properties: Object Name; Object Value; Description; Priority and Ack Required.
 - i. PROGRAM: This object shall have the following writeable properties: Object Name; Object Value and Description. In addition, this object shall support the property Reliability.
 - j. SCHEDULE: This object shall have the following writeable properties: Object Name; Object Value and Description; Effective period; Schedule; Exception; Controlled Properties and Write Properties.
 - k. TREND LOG: This object shall have the following writeable properties: Object Name; Description; Log Enable; Start/stop Times; Log Device Object Property; Log Interval; Stop When Full; Buffer Size; and Record Count.

2.10 ADVANCED APPLICATION CONTROLLERS

- A. General. Provide an adequate number of Programmable Application Controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these panels shall meet the following requirements.
 - 1. The Advanced Application Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 2. Advanced Application Controllers shall be fully peer to peer.
 - 3. The operating system of the Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information, and allow central monitoring and alarms.
 - 4. Both firmware and controller database shall be loadable over the network.
- B. Communication.
 - 1. Each Advanced Application Controller shall reside on a BACnet network using the MS/TP or Ethernet Data Link/ Physical layer protocol.

2. The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol for connection to portable operators' workstation and allow access to the entire network.
- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°C to 40°C [32°F to 100°F].
 2. Controllers used in conditioned space shall be mounted in dust proof enclosures, and shall be rated for operation at 0°C to 50°C [32°F to 120°F].
- D. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips — or to a termination card connected by a ribbon cable.
- E. Memory. The Advanced Application Controller shall be non-volatile FLASH memory.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

2.11 APPLICATION-SPECIFIC CONTROLLERS

- A. General. Application Specific Controllers (ASCs) are microprocessor-based DDC controllers which through hardware or firmware design are able to control a wide variety of equipment. They are fully user-programmable, and are not restricted to any one type of equipment.
1. Each ASC shall be capable of standalone operation and shall continue to provide control functions without being connected to the network
 2. Each ASC will contain sufficient I/O capacity to control the target system.
 3. Both firmware and controller database shall be loadable over the network
 4. Application Specific Controllers shall be fully peer to peer
 5. ASC's shall come with an integrated housing to allow for easy mounting and protection of the circuit board. Only wiring terminals shall be exposed.
- B. Communication
1. The controller shall reside on a BACnet network using the MS/TP Data Link/ Physical layer protocol.
 2. Each controller shall have a BACnet Data Link/ Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown and allow access to the entire network.
 3. Each controller shall have a secondary sub network for communicating sensors or I/O expansion modules
- C. Environment. The hardware shall be suitable for the anticipated ambient conditions.
1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°C to 65°C [40°F to 150°F] and/or suitably installed in a heated or fan cooled enclosure
 2. Controllers used in conditioned space shall be mounted in dust proof enclosures and shall be rated for operation at 0°C to 50°C [32°F to 120°F].
- D. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips.
- E. Memory. The Application Specific Controller shall use non-volatile memory and maintain all BIOS and programming information in the event of a power loss.
- F. Immunity to power and noise. ASC shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

- G. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.
- H. Input/Output. ASC shall support as a minimum, directly connected, a combination of analog outputs and binary outputs and universal software selectable analog or digital inputs. ASC inputs shall support 0-5 VDC-voltage, 4-20mA-current, thermistor-resistance and dry contacts. ASC outputs shall support 0-10 VDC-voltage, digital triac rated at 0.5 amps at 24 VAC

2.12 ENCLOSURES

- A. General Enclosure Requirements:
 1. Outdoors, Protected: Type 4.
 2. Outdoors, Unprotected: Type 4.
 3. Chiller and Boiler Rooms: Type 3R.
 4. Air-Moving Equipment Rooms: Type 1.
 5. Localized Areas Exposed to Washdown: Type 4.
 6. Within Duct Systems and Air-Moving Equipment: Type 3R.
 7. Within Return Plenums: Type 1
 8. Exception: An enclosure is not required for terminal unit controllers mounted directly to the terminal unit unless ambient hazards dictate otherwise.
- B. Internal Arrangement:
 1. Mount products within enclosure on removable internal panel(s).
 2. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components that are associated with a controller, but are not an integral part of controller.
 3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
 4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated. Field construction and assembly of enclosures is not acceptable.
 5. Terminate field cable and wire using heavy-duty terminal blocks.
 6. Include spare terminals for every unused point on all controllers in the panel.
 7. Include spade lugs for stranded cable and wire.
 8. Install a maximum of two wires on each side of a terminal.
 9. Provide permanent identification tags for enclosure, and for control products
 10. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
 11. Label each end of cable, wire and tubing in enclosure.
 12. Size enclosure internal panels to provide space to mount one relay for each Binary or Universal Output, including unused or spare points.
- C. Hoffman panels as basis of design.
 1. Internal panel mounting hardware, grounding hardware and sealing washers.
 2. Grounding stud on enclosure body.
 3. Thermoplastic pocket on inside of door for record Drawings and Product Data.
 4. Freestanding enclosures shall have
 - a. Nominal 4-inch-tall integral lifting base with predrilled holes for attachment to mounting surface.
- D. Accessories:
 1. Slot and tab latch with identically keyed padlock.

2.13 ELECTRIC POWER DEVICES

- A. Power Supplies & Control Transformers
 1. Basis of design PSH500 from functional devices.
 2. Provide 120V plug receptacle in all panels with terminal unit routers.
 3. Control transformers and power supplies shall be UL-Listed.

4. Provide Class 2 current-limiting type or over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements.
 5. Transformer shall be properly sized for application. Limit connected loads to 80% of rated capacity.
 6. Line voltage units shall be UL Recognized and CSA Approved.
- B. DC Power Supplies: DC power supply output shall match output current and voltage requirements. Power supply shall be full-wave rectified type with the following minimum Specifications:
1. Built-in overvoltage and overcurrent protection and able to withstand a 150% current overload for a minimum of three (3) seconds without tripping or failure.
- C. Power Contactors: General-purpose AC magnetic contactor complying with NEMA ICS 2.
- D. Control Relays
1. All control relays shall be UL listed, enclosed, with LED energized indicator.
 2. All relays shall have contact rating, configuration and coil voltage suitable for the application.
 3. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
 - b. Coil sealed volt-amperes (VA) not greater than 4 VA.
 - c. Pilot light indication of power-to-coil and coil retainer clips.
 4. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.
 5. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
- E. Uninterruptable Power Supplies
1. Eaton as basis of design.
 2. Unless specifically called for a particular piece of equipment, do not provide.
 - a. Note: see refrigeration monitor section.
 - b. Note: where applied, take note of all devices requiring UPS power to calculate size of UPS
 3. Provide unit with integral line-interactive, power condition topology to eliminate all power contaminants. It shall provide continuous, regulated output power without engaging batteries during brown-out, surge, and spike conditions
 4. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
 5. UPS shall provide 5 minutes of battery power at connected full load.
 6. Performance:
 - a. Input Voltage: Single phase, 120VAC, +20% to -30%.
 - b. Output Voltage: Single phase, 120 VAC \pm 3% steady state
 - c. On-Battery Output Voltage: True sine wave.
 - d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
 - e. Recharge time shall be a maximum of eight hours to 90 percent capacity after full discharge to cutoff.
 - f. Transfer Time: 600 ms.
 7. Engagement shall be automatic during fault or overload conditions.
 8. Include front panel with power switch and visual indication of power, battery, fault and temperature.
 9. Include an audible alarm of faults and front panel silence feature.
 10. UPS shall include dry contacts (digital output points) to signal low battery condition and battery on (primary utility power failure).
 11. Batteries shall be maintenance free.
- F. Power Conditioning Devices
1. Section not used.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. The DDC Contractor shall be responsible for his/her work and equipment until finally inspected, tested and accepted.
- B. The DDC Contractor shall protect his/her work against theft or damage and shall carefully store material and equipment received on site that is not immediately installed.
 - 1. Close all open ends of work with temporary covers or plugs during storage and construction to prevent damage/contamination by foreign objects and construction debris.
 - 2. Store equipment and materials in connex or inside to protect from weather.

3.02 COORDINATION WITH OTHER TRADES

- A. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the DDC Contractor shall assist in coordinating space requirements.
- B. Coordinate and schedule work with all other trades in the same area, or with work that is dependent upon other trades to facilitate mutual progress. Report all conflicts and anticipated delays to the General Contractor for resolution immediately upon identification.
- C. Control Products for Factory Installation
 - 1. Terminal units are acceptable
 - 2. DDC contractor assumes full responsibility, coordination labor, shipping and receiving, and training for factory mounting coordination.
 - 3. DDC Contractor is responsible for delivering equipment to manufacturers in a timely fashion to facilitate mutual progress and meet the Project schedule. Immediately notify General Contractor of any anticipated or probable delays in product availability or delivery which could impact construction schedule.
 - 4. DDC Contractor is responsible for coordinating, supporting, and verifying the installation of controls products by manufacturers. Provide all reasonable support required to ensure correct installation of control products.
 - 5. Verify correct function of control products upon receipt of equipment with control product installed.
- D. Setpoint Determination
 - 1. General: some of the system balance points specified in this set have been given initial values by the EOR that could require modification by the DDC contractor and TAB contractor. Prime Examples:
 - a. Return AHU remote duct static pressure. This is largely subject to building and shaft leakage which can only be assumed values in design phase. In practice a target value of 1" negative could possibly result in spaces that are running at the ends of throttling ranges - i.e. dampers trying to throttle at 90%-95% closed. In such an instance, the engineering judgement of DDC and TAB Contractors to apply a lower initial balance point would be not only welcomed, but actually important to the proper functioning of the building.
 - b. Note: ongoing optimizations and seasonal fine tuning is not part of the setpoint determination scope.
 - 2. DDC Contractor and TAB (Test and Balance) Contractor shall coordinate to determine the correct values for setpoints and other parameters required to program Sequences of Operations.
 - 3. Proper coordination is defined by document sharing of the following information:
 - a. DDC Contractor shall provide a list of setpoints and other parameters to be determined by the TAB Contractor.
 - b. The list of setpoints provided in Sequences of Operations may not be complete, so DDC Contractor is responsible adding any others.

- c. TAB Contractor shall develop necessary test processes and forms in accordance with Division 23.
 - d. DDC Contractor shall review and comment on planned tests to ensure that they will provide information required to correctly program Sequences of Operations.
- E. Life Safety: DDC System provided under this Section is not rated for and shall not perform life-safety control functions.
- 1. In general, the DDC system has no interaction with the fire alarm.
 - 2. Duct smoke detectors required for air handling unit shut down are provided under other Divisions and Sections of this Specification. DDC to pick up alarm input from VFD only.
 - 3. Fire/smoke alarm system is provided under another Division of this Specification.
 - 4. Smoke and fire-smoke duct isolation dampers and actuators are provided under other Divisions and Sections of this Specification. No BAS connection is required or permitted.

3.03 GENERAL WORKMANSHIP REQUIREMENTS

- A. Cleaning
- 1. Clean up all debris resulting from its activities daily. Remove all cartons, containers, crates, and other debris generated by Work in this Section as soon as their contents have been removed. Waste shall be collected and disposed of in accordance with Project waste disposal procedures. All recyclable materials shall be sorted into the appropriate bins.
 - 2. Materials stored on-site shall be protected from weather and stored in an orderly manner, neatly stacked, or piled in the designated area assigned by the Owner's Representative.
 - 3. At the completion of work in any area, clean all work and equipment of dust, dirt, and debris.
 - 4. Use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.
- B. All damage to and openings in ductwork, piping insulation, and other materials and equipment resulting from Work in this Section shall be properly sealed, repaired, or re-insulated by experienced contractors of the trade involved. Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.
- C. At the completion of Work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired and repainted to original finish.

3.04 SYSTEM SOFTWARE INSTALLATION

- A. General
- 1. DDC Contractor shall install and completely configure all System Software, supplemental software, networking stacks and interfaces on all servers and interface devices specified in this Section.
 - 2. DDC Contractor shall tune and adjust software as required to obtain a fully functioning system that provides stable control.
 - 3. Maintain all programming, graphics and data files in a logical system of directories with self-explanatory file names.
 - 4. All programming developed for the Project is the property of the Owner.
- B. System Software Packages
- 1. Operator's Web Interface (OWI): Provide and configure
 - 2. Operator Workstation
 - 3. Trend Database Software
 - a. Provide and configure. If "Not Required" then DDC Contractor may disregard the remainder of this Paragraph.
 - b. The size of the trend database shall be limited only by available storage. The database software shall not impose any limit on the database file size.

- c. Configure database to perform the following functions automatically without user intervention:

C. Security

1. System security permissions shall be multilayered, supporting at least 5 access levels with distinct viewing and editing privileges definable for each level. Initially define the following access levels:
 - a. Observer: Can view all parts of the DDC System interface but cannot override points, or issue commands or exert other control functions.
 - b. Regular Operator: Observer access plus the ability to perform all tasks
 - c. Advanced Operator: Observer access plus the ability to perform all tasks
 - d. System Administrator: Observer access plus the ability to perform all tasks
 - e. Superuser: Full and unrestricted access to all control system functions.
2. Each operator shall be required to log on to the system with a unique user name and password in order to view, edit, add or delete data.
3. User registration shall require an email address associated with each user, which is used to notify operator of errors and alerts as described elsewhere in this Section.
4. DDC Contractor shall coordinate with Owner or building maintenance staff for initial users, passwords, email addresses and associated access levels.
 - a. DDC System user/password database must be configured before system acceptance.
 - b. Configure exactly one (1) Superuser account (see above) in addition to accounts requested by Owner.
 - c. Default passwords shall not be used and shall be changed if present.
 - d. Passwords assigned to each user shall be unique to that user. Use minimum 8-character passwords.
5. All System Software Functions and host devices shall share a common set of usernames and passwords. The user database shall synchronize automatically and transparently among the devices hosting these functions.
6. Active Directory integration support shall be provided for assigning and enforcing security credentials and policies for operators.
7. Each operator shall be automatically logged-off of the system after a configurable period of inactivity.
8. Security data shall be stored and transmitted in an encrypted format, with 256-bit encryption.
9. Provide credentials information to Owner

D. Trends

1. All time-basis trends within a contiguous shall be synchronized so as to record data at the same time for ease of side-by-side comparison. Trends with the same time basis but offset timestamps (e.g. one-point trends at 1:00, 1:05, 1:10, etc. while another point trends at 1:02, 1:07, 1:12, etc.) shall not be subject to corrective action on the part of the DDC contractor.
2. Trends in this section are really intended just to demonstrate that the sequence of operation is executed. Not for fault detection, not for analytics or advanced mathematics, just the minimum to demonstrate functionality. DDC Contractor is ultimately responsible for demonstrating SOO to the satisfaction of the contract authority.
3. In general, trends have been relaxed to 5-15min intervals to alleviate un-due network traffic.
4. Program auto exports monthly using auto-export functions to support project M&V and other certification efforts.
5. Export recipient to be appropriately designated as internal personal for owner to turn over to project team. No automated external exports are appropriate for this project
6. Trend data shall be sampled and stored in controller memory. If Data Archive Server is provided, trend data shall be uploaded from panels to server on a user-defined interval, manual command, or automatically when the controller trend buffer becomes full.

7. DDC Contractor shall set up trends for all points listed in points schedules on Building Automation drawings. Unless otherwise indicated, trend all listed points as follows:
 - a. Binary points shall be trended on a change-of-value (COV) basis.
 - b. Analog points shall be trended on a time basis with a frequency of 5 minutes.
 - c. If an analog point is indicated for COV trending with a value in engineering units (e.g. "2°F COV"), provide trend which records a timestamp and point value every time the point value changes at least the given increment.
 - d. If an analog point is indicated for COV trending with a percentage value (e.g. "±10% COV"), provide trend which records a timestamp and point value every time the point value changes by at least that percentage of its current value.
8. In addition, DDC Contractor shall set up trends of setpoints as follows:
 - a. All fixed setpoints shall be trended on a COV basis, with one minimum of one data point recorded per day, at noon. (The minimum single data point provides a reference for subsequent trend analysis.)
 - b. All occupant-adjustable setpoints (e.g. at thermostats) shall be trended on a COV basis, with one minimum of one data point recorded per day, at noon.
 - c. For setpoints that are reset by a parameter (e.g. reset supply air temperature setpoint based on outdoor air temperature), trend both the setpoint and the resetting parameter on a time basis. Setpoint trend frequency shall be the same as the trend frequency for the physical point controlled by the setpoint, typically 5 minutes.
 - d. For setpoints reset by Request-based Trim & Respond logic. Trend the setpoint and the number of requests on a time basis. Trend frequency shall be equal to the time step of the Trim & Respond loop.
9. In addition, DDC Contractor shall set up trends of system parameters including the following:
 - a. Trend signal value for all control loops, except those that drive a single AO point that is already being trended.
 - 1) For example, do not trend both the speed of a fan and the analog output of the point commanding the fan speed, as their values will always be the same.
 - 2) For example, do trend the value of zone heating and zone cooling PID loops, as their output does not correlate directly to any command sent to physical equipment.
 - b. Trend all global overrides such as demand response signals and after-hours (i.e. "janitor button") system operation.
 - c. Trend all performance calculations, such as equipment efficiency or plant load, described in Sequences of Operations.
10. In addition, DDC Contractor shall map and set up trends of all equipment points listed in "Trends" in Part 1 of Sequences of Operations.
11. DDC Contractor shall not create duplicate trends of a single point. If a single point referenced for trending in this or other Sections appears more than once, that does not indicate that multiple trends shall be created. Create only one trend for any given physical or virtual point, unless specifically instructed otherwise.

E. Groups

1. Properly-credentialed operators shall be able to assign BACnet objects, parameters or points to groups manually, by type, or using wildcard search, and shall be able to apply batch modifications or overrides to an entire group with a single action.
2. DDC Contractor shall configure the following groups:
 - a. All zones, by Zone Group: Assign each zone to a Zone Group, as defined in the Sequence of Operations.
 - b. All zones by floor
 - c. All equipment by system/function
 - 1) Assign all devices associated with each major system or subsystem (e.g. chiller plant, boiler plant, air handler) to a separate group.

- 2) If there are multiple independent units (e.g. air handlers), create a separate group for each one. If there are multiple interdependent units (e.g. boilers in a plant) put all interdependent units in the same group.
 - 3) Include with each system group all associated devices (e.g. pumps for plants) and sensors (including physically distance differential pressure or flow sensors, if used for control).
 - 4) For each air handler, all terminal units for a given air handler should be in a distinct group; i.e. separate from the air handler (so that overrides can be applied to the terminal units) and separate from groups of terminal units associated with other air handlers.
- d. All equipment by floor: Assign all networked control devices to a separate group based on the floor that the device serves (not necessarily where the device is physically located).
3. A single object or point may belong to more than one group. If multiple overrides conflict on a single object, the one with the highest assigned priority shall prevail.
- F. Schedule Configuration
1. Configure normal operating schedules. Schedules shall be applied to zone scheduling groups as described in Sequences of Operations.
 2. Configure holiday schedules for federal and state holidays, unless otherwise noted or instructed by Owner.
 3. Configure exception schedules as requested by Owner.
 4. The schedule objects shall reside in each individual controller or device. Each controller shall locally store schedule objects related to its controlled equipment or systems.
- G. Alarm/Event Programming, Configuration and Handling
1. Contractor shall define four alarm levels/categories:
 - a. Level 1: Critical Notify Alarm
 - b. Level 2: Critical Alarm
 - c. Level 3: General Alarm
 - d. Level 4: Maintenance Alarm
 - e. Level 5: Minor Issue
 2. DDC Contractor shall program alarms and associated alarm levels per Sequences of Operations using BACnet Event templates. Alarm messages shall use verbose English language names and descriptions such that the source, location and nature of the alarm is easily understood.
 3. Adjust alarm parameters as required to minimize nuisance alarms while identifying genuine alarm and fault conditions.
 4. DDC Contractor shall configure alarm handling as follows:

	Level 1	Level 2	Level 3	Level 4 & 5
Criticality	Critical	Not Critical	Not Critical	Not Critical
Alarm Acknowledgement	Required*	Required	Not Required	Not Required
Acknowledgement of Return to Normal	Required*	Not Required	Not Required	Not Required
Notify by email	Y	Y	Y	N
Notify by pop-up at graphical interface	Y	Y	N	N
Remove from current alarm log	After Acknowledged		After 2 weeks	

*Level 1 alarms must be acknowledged individually.

**Level 1 alarm notifications shall repeat every hour until acknowledged.

5. Notifications shall be sent to all users of Advanced Operator or higher access level or otherwise as specified by Owner.

3.05 GRAPHICAL USER INTERFACE

A. General

1. Graphical user interface shall be an intuitive multi-window image-based interface for navigating, monitoring, and controlling devices within the DDC System.
 - a. Interface shall be constructed to have the look and feel of a single application. All graphical screens shall be designed and laid out to provide a uniformly high quality and consistent user experience across displays for different systems.
 - b. Graphical elements shall be hyperlinked such that clicking on an element will “drill down” to the next level of detail. (E.g. clicking on an air handler graphic in a system-level schematic will display the interface screen for that air handler; clicking on a fan icon will display detailed information about that fan and its associated VFD.)
 - c. When clicking a link, the operator shall have the option of opening the new view in the same window, or in a new window with e.g. a right-click selection. The default shall be to open the new view in the same window.
 - d. Every page shall have a “back” button to return to the previous screen and a “home” button to return to the top level or site overview page.
 - e. Use colors in a consistent, logical and intuitive way.
2. On all screens, status lamps and displayed text associated with a device (e.g. fan status, or sensor reading) shall correspond to the condition of the device:
 - a. Normal operation: Text shall be white, black or other neutral color as appropriate to the background. Status lamps shall be green, or operation may be indicated by an animation.
 - b. Manually disabled or offline: Grey (select a shade that provides visible contrast with the background).
 - c. Level 1 or Level 2 alarm condition: Red text and lamp.
 - d. Levels 3 through 5 alarm condition: Yellow text and lamp.
3. All equipment shall be identified on graphics by the unit tag as scheduled on the drawings.
4. All devices and controlled equipment that appear multiple times (e.g. VAV boxes) shall use a single graphic template so that any updates are automatically applied to all applications

with a single action. Displayed points shall be automatically populated using wild cards for point names in graphic template.

5. Display global readings such as time, outdoor air temperature, humidity, and wind speed (as applicable/available) in the upper left corner of every graphic page.
6. Clicking on the display of any point on any graphics page shall open an override screen
7. Any point that is overridden by the operator shall indicate the overridden condition on every graphic page where that point appears. Override shall be indicated by flashing icon or text, or other means so that status is visually obvious at a glance.
8. If controllers support supervised manual override, points in supervised manual override shall also be indicated on graphics, in a fashion similar to but distinct from operator overrides performed through the DDC System interface.
9. For each graphic page, provide a text box for use by operators to record operational notes about the system. Text box shall expand or scroll in order to accommodate an arbitrary amount of text, without covering or obscuring system graphics.
10. All users shall be required to log in with proper credentials to access any control graphic.
11. Contract Drawings will be made available to DDC Contractor upon request for use in developing backgrounds for graphic screens. These drawings are provided without guarantee that they will be suitable for the Contractor's purpose.

B. I/O Points and Setpoints

1. The current value and point name of every I/O point and setpoint shall be shown on at least one graphic page and in its appropriate physical location relative to building and mechanical systems.
2. Verbose names (English language descriptors) shall be included for each point on all graphics. This may be accomplished by a pop-up that appears when hovering the mouse over the displayed point.
3. All analog points and setpoints shall be displayed with appropriate engineering units.
4. For all controlled analog points, display the current setpoint adjacent to the current value of the point.
5. Adjustment of Setpoints: All setpoints shall be adjustable directly within the graphics screen where they appear. It shall not be necessary to open a separate window to make a setpoint adjustment.
 - a. Adjusting a setpoint is not the same as overriding it. It shall be possible to override a setpoint (see below) as well, but overrides shall not be used in place of adjustable setpoints. Both features shall be provided.
 - b. Adjustments are permanent until changed.
 - c. Fixed setpoints shall be adjustable.
 - d. For setpoints that are reset by another parameter, both the setpoint range and the reset parameter range shall be adjustable. E.g. If a supply temperature setpoint is reset by outdoor air temperature, it shall be possible to adjust the minimum and maximum values of the supply temperature setpoint and also to adjust the minimum and maximum values of outdoor air temperature against which the setpoint is reset.
 - e. For setpoints that use a Request-based Trim & Respond reset logic, all parameters shall be adjustable.
 - f. For setpoints that automatically reset, it shall be possible to use an override to lock the current setpoint to a fixed value.
 - g. It shall be possible to constrain the range of a setpoint in programming, such that it cannot be adjusted outside of this range. Setpoints shall be able to be overridden to any value irrespective of these constraints.
6. For all setpoints, display the original as-designed or as-balanced setpoint next to the current setpoint. The as-designed setpoint is for reference by future operators and is static: it is not used for control and shall **not** be able to be adjusted or overridden – the use of an image element rather than a BACnet object is recommended. The as-designed setpoint shall be clearly identified as such.

7. Override of Points: All physical and virtual points shall be able to be overridden
 - a. When any point is clicked on any graphics page, open a window that displays all of the object's BACnet properties with an interface allowing points to be locked, overridden or returned to automatic control.
 - b. The operator shall be able to establish timed overrides which automatically release after a period of time, and indefinite overrides which remain in effect until released or changed.
 - c. Overrides shall require the user to click accept/apply before changes take effect. In other words, simply changing a value in a dialog box does not trigger the override – the operator must positively apply the change.
 - d. A point in override shall indicate that status on every page where it appears, and shall appear in the summary of overridden points.

C. User Interface Architecture

1. Interface shall consist of a collection of graphical interface pages that provide the operator with various ways to view and control the DDC System and its components, as described below.
2. Graphical interface pages shall be displayed in a multi-window environment to support operator multi-tasking.
 - a. User shall be able to close any window without affecting other windows.
 - b. User shall be able to minimize any window without closing it.
 - c. Interface shall be able to support an arbitrary number of windows, limited only by the memory and processor capacity of the host computer.
3. Graphical interface pages shall be connected by hyperlinks. When following a link, the user shall be able to choose to open the new interface page in a new window or in the same window.
4. Each window shall be to display a variety of graphical interface pages serving different purposes, including at least the following:
 - a. Site and building overviews
 - b. System navigation tree
 - c. BACnet network map
 - d. Floor plan graphics
 - e. Equipment graphics
 - f. Controller and network device graphics
 - g. Summary pages
 - h. BACnet properties and point overrides
 - i. Schedules: Create, modify, view and apply normal, holiday and exception schedules
 - j. Alarms/Events: View, sort and acknowledge current and historical events.
 - k. Trend and Runtime Logs: Create new trend logs, and display current or historical trend and runtime data, including control of colors, date range, axis and scaling,
 - l. Logic Programming and Configuration: An interface for programming controllers with sequence of operation logic

D. Site/Building Overview

1. If DDC System serves multiple buildings, provide a site overview graphic showing at least all connected buildings. Clicking on a building shall display the associated building overview graphic. If DDC System serves only one building, site overview may be omitted.
2. For each building, provide an overview consisting of floorplan(s) with all mechanical equipment shown in its approximate physical location.
 - a. Clicking on any equipment shall open the associated equipment control graphic
 - b. For each floor, provide a "zone map" button to open the floor plan graphic
 - 1) If there are multiple zone types, provide a compound button or multiple adjacent buttons so that user may select the zone map for a specific type of zone.

- 2) If there is only one zone type and space permits, the building overview may be combined with the floor plan graphic. All equipment and all zones must be easily identified and selected.
- E. Display global readings such as outdoor air temperature, humidity, and wind speed on weather tab.
- F. System Navigation Tree
1. Provide hierarchical “tree” of equipment controlled by DDC System, similar to the Windows Explorer navigation tree.
 2. Tree structure shall be based on the physical relationships between the devices being controlled (e.g. the VAV boxes served by an AHU shall be shown as “children” of that AHU).
 3. Only controlled equipment and devices that provide control functions shall be displayed in this view. Devices dedicated to routing, protocol translation or other pure networking functions shall not be displayed.
 4. Display each piece of equipment as a separate object, even if they are attached to the same controller (e.g. multiple pumps serving a single plant shall be shown individually, as “child” objects of the plant equipment that they serve).
 5. Navigation tree shall support expansion and collapse of individual levels of the tree, or of all levels simultaneously.
 6. Clicking on any element of the tree shall open the graphic page for that equipment or zone.
- G. Floor Plan Graphics
1. For each floor, provide one or more zone maps overlaid on floor plan graphics.
 - a. Contract Drawing mechanical plans may show multiple types of zone. In that case, provide color coded zone maps for each type of zone as described below.
 2. Thermal Space Control Zones
 - a. Provide separate zone map for Thermal Space Control zones as shown on plans.
 - b. Display the associated zone (air) temperature and setpoint at each zone.
 - c. Also indicate zone temperature relative to active (occupied or unoccupied) setpoint graphically by coloring the zone area according to the following scheme:
 - 1) Red: Space temperature is above cooling setpoint by more than the adjustable threshold.
 - 2) Yellow: Space temperature is above cooling setpoint by less than the adjustable threshold.
 - 3) Green: Space temperature is between cooling and heating setpoints and space is in Occupied Mode.
 - 4) Gray: Space temperature is between cooling and heating setpoints and space is in Unoccupied Mode.
 - 5) Light blue: Space temperature is below heating setpoint by less than the adjustable threshold.
 - 6) Dark blue: Space temperature is below heating setpoint by more than the adjustable threshold.
 - 7) The initial value of the adjustable threshold shall be 3°F. Threshold shall be adjustable for each zone individually or for all zones together.
 - d. Display occupancy sensor status for zones with occupancy sensors connected to DDC System or mapped from lighting control system.
 3. Ventilation Control Zones:
 - a. If Ventilation Control zones are indicated on mechanical plans, provide a separate zone map for Ventilation Control zones.
 - b. For zones with a CO₂ sensor, display CO₂ reading and setpoint (PPM), and the value of the CO₂ control loop (%signal). Also indicate CO₂ level graphically by coloring the zone area according to the following scheme:
 - 1) Red: CO₂ reading is above setpoint for more than 10 minutes.
 - 2) Green: CO₂ reading is below setpoint.

- 3) Blue: CO₂ reading is less than outdoor ambient or 400 PPM if no ambient CO₂ sensor (indicating sensor or measurement problems)
- c. Display zone airflow and airflow setpoint for zones with airflow measurement at the terminal unit.
- d. If Ventilation Control Zones are not indicated as a separate zone type on mechanical plans, display setpoints and current readings for CO₂ and airflow on Thermal Space Control zone map alongside temperature values. In that case, do not apply color coding based on CO₂ level.
- 4. Color schemes described above shall dynamically update in real time as zone conditions change.
- 5. Clicking on any zone in any map shall jump to the graphical page for the equipment serving that zone, if any. (Spaces with no associated equipment or sensors shall not provide links.)
- 6. For each zone participating in a Trim & Respond scheme to reset airflow/static pressure or supply air temperature, display current number of Requests generated by that zone and the zone's Importance multiplier. Importance multiplier shall be adjustable.
- 7. For each zone subject to scheduling, provide a link or other means to identify all the schedules that apply to that zone, including the priority of each schedule.
- 8. If multiple views are necessary to show all areas of a single floor, provide a graphic building key plan that links to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen back to the building key plan and to each of the other graphic floor plan screens for that floor. The key plan view may be combined with the building overview so long as each part of the key plan is readily visible and selectable.

H. Equipment Graphics

- 1. Provide one or more equipment graphics pages for each piece of equipment controlled or monitored by the DDC System.
- 2. Equipment graphics shall be based on the Building Automation drawings and/or mechanical schematics and details.
- 3. Animations or color shall be used to indicate on/off status of mechanical components.
 - a. Green = Equipment is running in automatic, no alarm
 - b. Red = Level 1 or Level 2 alarm
 - c. Orange = Level 3 or Level 4 alarm
 - d. Grey = Equipment is off in automatic
- 4. Position of every valve and damper shall be shown adjacent to the device. Two-position devices may indicate state solely by animation of the graphic element, but all modulating devices shall also indicate commanded position and (if available) position feedback.
- 5. Hydronic system piping shall be labelled with type of water and also color-coded as follows:
 - a. Heating hot water supply: Red
 - b. Heating hot water return: Orange
 - c. Chilled water supply: Light/bright blue
 - d. Chilled water return: Dark blue
 - e. Condenser water from tower to chiller: Dark yellow or orange (but distinct from HHWR color)
 - f. Condenser water from chiller to tower: Bright yellow
 - g. Domestic hot water: Light green
 - h. Domestic cold water: Dark green
 - i. Greywater: Purple
 - j. When there is more than one loop of a given type (e.g. high and low temperature chilled water), they shall be distinguished by labels. Label each type of pipe on every screen where it appears.
- 6. Flow in hydronic pipes shall be indicated by animation or by the appearance of arrows when flow is present.
- 7. Each equipment page shall display all physical I/O points and relevant virtual points including setpoints and setpoint reset parameters.

- a. Setpoints and actual point values shall always appear on the equipment page.
 - b. For setpoints reset by request-based Trim & Respond logic, also display on the equipment page the current number of Requests and the last action taken by the logic block (“trim”, “respond”, or “hold”).
 - c. Provide the ability to view and adjust all setpoint reset parameters (including all parameters used for Trim & Respond logic, where applicable). If space on the equipment page is insufficient, parameters may be viewed and adjusted from linked page or pop-up box.
8. Where multiple Mode-dependent setpoints exist (e.g. chiller with a regular cooling setpoint or reset, and a lower setpoint for dehumidification), all setpoints shall be displayed at all times, with the active setpoint clearly indicated. For example, the active setpoint may be in a bright neutral color while the inactive setpoints are in grey.
 9. Complex systems (e.g. chiller and boiler plants) plants shall have a graphic page for the system as a whole, showing all associated sensors and ancillary equipment. Clicking on any piece of equipment shall open graphic page for that equipment.
 10. Pages for terminal units shall include links to the associated air handler and to the floor plan where the zone is located.
 11. Pages for terminal units shall also display information about the zone served. Information displayed shall depend on the type of zone.
 12. Each equipment page shall have a link to open the graphics page for its associated controller.
 13. For each piece of equipment generating Trim & Respond reset requests, display current number of Requests generated by that equipment and the equipment’s Importance multiplier. Importance multiplier shall be adjustable. (See Sequences of Operations for explanation of Importance multiplier.)
 14. For each piece of equipment subject to scheduling, provide a link or other means to identify all the schedules that apply to that equipment, including the priority of each schedule.
 15. On graphics page for each system or subsystem, provide links to display the English-language control sequences and the O&M and submittal information.
 - a. Information shall be in a text format that can be searched or copy/pasted to another application. Information shall not be editable from this interface.
 - b. Links shall provide this information only for the associated equipment shown on the page, or shall jump to the appropriate bookmark in a longer document.
 - c. Linking to the entire sequence or O&M document, without bookmarks, shall not be accepted.
 16. For all equipment with runtime alarms specified in Sequences of Operations, show on graphic adjacent to equipment the current runtime, runtime alarm setpoint, alarm light, date of last runtime counter reset, and alarm reset/acknowledge button which resets the runtime counter.
 17. For all equipment with lead/lag or lead/standby operation specified in Sequences of Operations, show on graphic adjacent to equipment the current lead/lag order and manual buttons or switches to allow manual switching of lead device by the operator.
- I. Integrated points to appear on the equipment page they are associated with.
- J. Schedules
1. Support all scheduling functions
 2. Provide interface to create, edit, delete and view binary, analog and multistate BACnet Schedule objects and parameters.
 3. Hierarchical Schedules: The system shall allow operators to define schedules in terms of systems of related equipment.
 4. Group Schedules: The system shall allow operators to apply any schedule to any group.
 5. User shall be able to apply priority level to any schedule.
 6. Conflicting schedules shall be resolved as follows
 - a. First, the schedule with the highest priority shall prevail.

- b. If conflicting schedules have equal priority, the schedule with the smallest scope (i.e. fewest zones, or fewest devices) shall prevail.
 - 7. Provide at least the following schedule views for any object or set of objects:
 - a. Daily view showing all scheduled transitions, including start and end times and transition action, in a timeline or date-keeper format.
 - b. Views showing all scheduled transitions for the calendar week, for the calendar month, and for the next 30 days. Transition indications may be abbreviated in these views. Clicking on a day shall bring up the daily view with full details of the scheduled transitions.
 - c. Schedule summary: Show normal versus holiday versus override schedules, and the net operating schedule that results from all contributing schedules.
- K. Alarms and Events
1. Alarms shall be displayed on the interface graphics for the system that the alarm is associated with (e.g. a fan alarm shall be shown on the graphic of its associated air handler).
 - a. Display brief description of alarm (e.g. "failure to run", "low pressure", etc.) next to image of device or sensor status/output.
 - b. Alarm notice and device status/output text shall appear in color based on alarm condition
 2. When there are unacknowledged alarms, a lamp or icon indicating this shall be displayed at the interface.
 - a. This indicator shall be clearly visible but not obtrusive, and shall not cover other interface elements.
 - b. This indicator shall flash for critical alarms.
 3. Each new alarm shall appear in the log of current alarms
 - a. Alarms shall be recorded in the log with at least the following information:
 - 1) Date and time of the alarm
 - 2) Level of the alarm
 - 3) Source of alarm
 - 4) Description of the alarm
 - 5) Equipment tags for devices in alarm
 - 6) Possible causes of the alarm, if provided by the fault detection routines (see Sequence of Operations)
 - b. Operator shall be able to acknowledge or reset alarms from the alarm log screen. Alarms may be acknowledged in batches, except for Level 1 alarms.
 - c. When alarms are acknowledged (or time out), they shall be removed from the current alarm log and stored permanently in the alarm history log, recording time of acknowledgement and identity of the acknowledging operator.
 - d. Operator shall be able to view all current and historical alarms from any location in the internetwork.
 - e. Operator shall be able to sort alarms based on level, time/date, and current status within both the current and the historical alarm logs.
 - f. Alarm logs shall be able to be exported as a spreadsheet or CSV formatted file.

3.06 CONTROL INTERNETWORK INSTALLATION AND CONFIGURATION

- A. General
 1. BACnet network numbers and Device Object IDs shall be unique throughout the internetwork.
 2. If the DDC System provided under this Section is to integrate with an existing building control network, DDC Contractor shall coordinate assignment of network numbers and Device Object IDs with the Owner or facility staff to ensure that no duplicate network numbers or device IDs occur.
- B. Network Resilience

1. The system shall automatically monitor the operation of all network devices and annunciate any device that goes off-line because it is failing to communicate

C. Network Device Naming Convention

1. MAC Address:
 - a. Every network device shall have an assigned and documented MAC address unique to its network.
 - b. Ethernet Networks: Document MAC address assigned at its creation.
2. Network Numbering:
 - a. Assign network identification in accordance with Appendix B of BAS requirements provided by Owner.
3. Device Object Identifier Property Number:
 - a. Assign device identification in accordance with Appendix B of BAS requirements provided by Owner.
 - b. Provide to change device instance number by device switches or operator interface.
4. Device Object Name Property Text:
 - a. For each device, assign unique device name using BACnet Object Name property.
 - b. Names shall be a plain English description of function, device type, and service location.
 - c. Equipment shall be named in accordance with Naming Convention defined in Appendix B of BAS requirements provided by Owner.

3.07 DDC CONTROLLER INSTALLATION

A. Physical Installation

1. Controllers and associated devices shall be assembled into panels or enclosures by DDC Contractor in a workshop environment.
2. Install controllers in enclosures as required by field conditions and this Section.
3. Install all controllers in readily accessible location.
4. Install controllers such that they can be quickly and easily disconnected from the network.
5. For every controller, provide a dedicated power switch if the controller does not include one built in.
6. Connect controllers to power such that both the control component and the equipment are powered from the same panel.
7. Connect controllers to a power source of equal reliability (normal, emergency, uninterruptable, etc.) to the power source of the equipment being controlled.
8. HVAC systems and equipment served by a backup power source or UPS shall have associated DDC system products that control such systems and equipment also served from a backup power source or UPS.
9. Connect sensors, actuators and other attachments such that they can be quickly and easily disconnected for service. All wiring connections shall be made to field-removable, modular terminal strips.

B. Functional Installation

1. Configure DDC System to share data between networked controllers and other network devices.
 - a. Point information from any controller (including BCs, AACs, and ASCs) and from any gateway shall be capable of being used in a control sequence in any other panel.
 - b. The use of a computer or another DDC device as a communications server between control panels and/or gateways is not acceptable.
2. Each individual mechanical system or piece of equipment shall be controlled by no more than one controller with sufficient capacity to be connected to all field devices and sensors associated with that system and/or piece of equipment.
 - a. All points associated with and common to one unit or other complete system or equipment shall reside within a single controller (including I/O expander boards as

allowed below). Point data which may be transmitted over the LAN are limited to the following exceptions:

- 1) Global points such as outdoor air temperature.
 - 2) Requests sent from zones to systems or systems to plant, used to trigger equipment operation or reset setpoints.
 - 3) Mode information sent from zones to systems or systems to plant, used to select or change operating logic.
 - 4) Notwithstanding these exceptions, all operations required to maintain a controlled variable at setpoint must still be performed entirely within a single controller.
- b. Sensors used to measure error between a controlled variable and a setpoint shall always be hardwired directly to the controller, even if the sensor is physically remote from the controller (e.g. an end-of-loop differential pressure sensor). Transmitting the sensor signal to the controller over the LAN is not acceptable.
 - c. Control of a single piece of mechanical equipment performed by or distributed among multiple controllers, even within the same cabinet, is not acceptable.
3. Configure controllers for automatic safe restart after a loss of power:
 - a. If programming is intact, the controller shall resume full operation without operator intervention. All monitored functions shall be updated.
 - b. If battery backup has been exhausted or programming is lost for any reason, the controller shall automatically report this condition and prepare to receive a download over the network.
 - c. The controller shall automatically reset its clock such that time dependent functions occur on schedule without a manual reset.
 - d. The DDC Contractor shall pre-configure staggered start such that the startup surge or inrush current of each major piece of equipment (air handling unit, boiler plant, chiller plant, etc.) has time to resolve before the next start event.

C. Point Structure and Naming

1. The following applies to all physical I/O points, virtual points, and application program parameters.
2. Points shall be named and identified in a completely consistent and rigorous fashion throughout the DDC System.
 - a. Consistency shall extend to capitalization, use of separator characters, etc. For example, points named *AHU-1.ReturnAirTemp* and *Ahu2.return_air_temp* in the same Project would not be acceptable.
3. Point Naming Convention: DDC Contractor shall name all points in accordance with Appendix B of BAS requirements provided by Owner.

D. Point Summary Table

1. DDC Contractor shall provide a Point Summary Table which shall serve as the master list of all physical points for the Project.
2. Table shall include the following information:
 - a. Building identification (number or name) if more than one in Project
 - b. System type
 - c. Equipment type
 - d. Point suffix
 - e. Full point name (see Point Naming Convention above)
 - f. Point description
 - g. Ethernet backbone network number
 - h. Network number
 - i. Device ID
 - j. Device MAC address
 - k. Object ID (object type, instance number)
 - l. Engineering units

- m. Device make and model number
 - n. For sensors, range of device
 - o. Device physical location description if applicable. Include floor and column line intersection to one decimal place (e.g. line 6.2 and line A.3).
3. Provide a Point Summary Table on each shop drawing schematic, for the points associated to that schematic only.
 4. Also provide a Master Point Summary Table in electronic format as a single Excel spreadsheet listing all physical points in the Project.
 - a. Each parameter listed above shall be a separate column heading, such that it is possible to filter or sort by any point parameter.
 - b. Submit digital version of Point Summary Table with Submittal Package 1.
 5. DDC Contractor shall provide Point Summary Table (with updates as required) to the Commissioning Authority as a reference and guide during the commissioning process.
 6. DDC Contractor shall maintain Point Summary Table current and up-to-date throughout the duration of the Project.
 7. Project closeout documents shall include an accurate as-built Point Summary Table.
- E. Point Programming
1. Connect and configure I/O points for all points shown on Building Automation drawings
 - a. Points indicated on Building Automation Drawings as hardwired must be connected as hardwired points
 - b. Points indicated as networked may be hardwired or networked, at the option of the DDC Contractor, unless otherwise indicated on Building Automation Drawings.
 2. Connect and configure all network equipment points listed in "Trends" in Part 1 of Sequences of Operations.
 3. Set up and configure trends for all points.
 4. Provide templates customized for point type, to support efficient input of individual point information in a standardized format using standard BACnet Objects, including long-name field.
 5. Program at least the following information for each analog input point:
 - a. Name
 - b. Address
 - c. Scanning frequency or COV threshold
 - d. Engineering units
 - e. Offset calibration and scaling factor for engineering units
 - f. High and low signal bounds (reasonableness values), which shall prevent control logic from using shorted or open circuit values
 - g. Default value to be used when the actual measured value is not reporting or is out of bounds
 - h. Alarms as specified in Sequence of Operations.
 - i. Selectable averaging function that shall average the measured value over a user defined number of scans for reporting
 6. Program at least the following information for each analog output point:
 - a. Name
 - b. Address
 - c. Output updating frequency
 - d. Engineering units
 - e. Offset calibration and scaling factor for engineering units
 - f. Output range
 - g. Default value to be used when normal control logic is unavailable
 - h. For VFD minimum speed command, program
 7. Program at least the following information for each binary input point:
 - a. Name
 - b. Address

- c. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - d. Debounce time delay
 - e. Alarms as specified in Sequence of Operations.
 - f. Runtime logging and totalization
 - g. For equipment status, set ON/OFF signal threshold
 - 8. Program at least the following information for each binary output point:
 - a. Name
 - b. Address
 - c. Output updating frequency
 - d. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - e. Minimum on-time
 - f. Minimum off-time
 - g. Runtime logging and totalization
 - h. Default value to be used when normal control logic is unavailable
 - 9. Each point associated with a hardware device, sensor or instrument shall have its BACnet long-name point description field filled out with the following information:
 - a. Device manufacturer
 - b. Device model number
 - c. Description of point function
 - d. For sensors, range
 - e. For space sensors, room number where the sensor is located
 - 10. All hardware and software points, including all physical inputs and outputs, shall be able to be overridden by the operator
- F. Equipment Status Binary Input Threshold Adjustment
- 1. Current switch sensing status of fan with discharge damper: Fan status is OFF when fan discharge damper is fully closed.
 - 2. Current switch sensing status of fan with belt-driven fan: Fan status is OFF when fan belt is broken.
 - 3. Current switch sensing status of pump: Pump status is OFF when pump is dead headed.
 - 4. For differential pressure sensor used as a flow switch: Pump status is ON when all valves are open (i.e. pump is out on its curve).
- G. Variable Frequency Drive (VFD) Programming
- 1. The speed analog output sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz and 100% speed corresponds to maximum speed configured in the VFD.
 - 2. Speed signal shall scale linearly from 0% to 100%. For example, if the maximum speed is 80Hz (as is the case with some fan arrays), then a 50% speed command signal would correspond to device speed of 40Hz.
 - 3. For each piece of equipment, the minimum speed shall be stored in a single BMS software point. This value shall be written to the VFD's minimum speed setpoint via the drive's network interface. In the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BMS.
 - 4. Determine minimum speed
- H. Loop Tuning
- 1. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot.
 - 2. A loop shall be deemed stable if, within 3 minutes after being perturbed while in normal operation, it returns to setpoint within tolerances
 - 3. Record tuning parameters and response test results for each control loop in the Pre-Functional Test report.

3.08 IDENTIFICATION

- A. General

1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
2. Identifiers shall match that shown on submitted and approved control shop drawings or Building Automation drawings or schedule.

B. Equipment and Devices

1. Controllers and control products:
 - a. Indicate controller identification (matching shop drawings) or control product function, and equipment being controlled.
 - b. If control product is installed in an enclosure, provide tags on the control products and duplicate tags on front of enclosure so that enclosure contents may be easily identified.
2. Panels and Enclosures
 - a. Inside each 24V transformer used for terminal units use adhesive backed printout with schematic representation of what terminal units are served by each circuit.
 - b. Provide 2 inches high laminated white phenolic nameplate with engraved or raised black lettering, 1 inch high. Permanently affix to exterior of enclosure.
 - c. Indicate panel identifier and service.
 - d. Indicate the electrical panel and circuit number from which enclosure is powered.
 - e. Provide permanent documentation for each AHU, Boiler, and Chiller enclosure, including the following:
 - 1) A complete set of as-built schematics, tubing, and wiring diagrams and product literature applicable to control products in that enclosure. Install documentation in a pocket on inside of door. (For enclosures with windows, attach pocket to interior bottom of enclosure.)
3. Terminal units: provide 1" printed label with name of terminal unit that matches the equipment schedule.
 - a. For units above drop ceilings, permanently affix to bottom of terminal unit such that it is visible from below with a ceiling tile removed.
 - b. For units above a hard ceiling, permanently affix to side of terminal unit such that it is visible from nearest access hatch.
4. Thermostats and room sensors: Provide ½" high plastic film label with printed black lettering ¼ inch high on white background.
5. Static pressure pickups (for building and duct static pressure): Provide ½" high plastic film label with printed black lettering ¼ inch high on white background, indicating device service.

C. Wiring and Tubing

1. Provide self-laminating, self-adhesive typed labels. Marker pen, including indelible marker, is not acceptable. Hand-written labels are not acceptable.
2. Permanently label or code each point of field terminal strips to show the instrument or item served.
3. All wiring, cabling and tubing, including that within factory fabricated panels, shall be labeled at each end within 2 inches of termination.
 - a. Label shall indicate origination ("IN FROM") and destination ("OUT TO") devices.
 - b. Power wire labels shall include service, voltage, and breaker source.
 - c. Communication wire labels shall include the BAS address, BACnet object instance, or termination number.
 - d. Sensor and signal wire labels, and pneumatic tubing labels, shall include device function being sensed (e.g. "CHW Supply Temp") or controlled (e.g. "Return Air Damper"). Label text shall match nameplate used at sensor or control device.
4. Labels shall be applied at field I/O connection and at all intermediate connections throughout length to controller connection.

3.09 POWER WIRING INSTALLATION

- A. Div 25 contractor to provide documentation with panel locations and load requirements to Div 26.
- B. Where wiring specifications differ between Division 25 and other divisions, Division 25 shall take precedence when pertaining to 24V wiring and conduit. This includes all IO, comm, and serial networks.
- C. The requirements of this Section shall not supersede the requirements of code or of the AHJ.
- D. Ethernet and Fiber network requirements are to be governed by Div 26 and Div 27 requirements.
- E. Requirements and installation practices for conduit in the pour are to be governed by the Div 26, associated civil and concrete sections and any GC project requirements. DDC contractor assumes responsibility for all instances where required or elected.
- F. Underground conduit and wiring is only required where meters or alarm devices are necessarily located underground. Such wiring to be governed by associate spec sections and provided by respective trades.
- G. DDC contractor to ensure signal immunity to all sources of noise. Plan wiring routing accordingly by keeping adequate distance from transformers, motors, VFDs, etc. Spotty signal will require DDC contractor to re-route wiring at no additional cost during first year of warranty.
- H. The selection and installation of line-voltage power wiring and wiring connections, including subpanels, conduit and raceways, required for Work in this Section shall be provided by the Division 26 contractor based on control panel locations pre-coordinated with the DDC Contractor.
- I. The selection and installation of low-voltage power wiring and wiring connections, including subpanels, conduit and raceways, required for Work in this Section shall be provided by the DDC Contractor.
- J. All 120V to BMS panels provided by division 26. General requirements for obtaining power include the following:
 - 1. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it.
 - 2. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120V source fed from a common origin.
 - 3. Where control devices are located in or on new equipment, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or not of the correct voltage to supply the controls, provide separate transformer(s).
 - 4. Unless transformers are provided with equipment, DDC Contractor shall provide transformers for all low voltage control devices including terminal units. Transformer(s) shall be located in control panels in readily accessible locations.
- K. Emergency, Uninterruptible, and Backup Power
 - 1. UPS and Emergency power is not the responsibility of the DDC contractor unless otherwise indicated for a specific piece of equipment.
 - 2. Said power to be design and implemented in full by Division 26 engineer/contractor.
- L. Work shall comply with NEC with all state and local amendments, and all requirements of Division 26 Specification for power wiring.

- M. Do not run power wiring and signal or communication wiring in the same raceway or conduit in the following instances:
 - 1. Valve power for valves over 2"
 - 2. AHU damper power
 - 3. All central plant and cooling tower applications
- N. All field wiring shall be properly labeled at each end for the following:
 - 1. All central plant IO and comm
 - 2. All AHU IO and comm
 - 3. All terminal unit comm (no IO)
 - 4. For radiant, trench convectors, and building pressurization dampers if controller is not directly accessible by the equipment it serves, all comm and IO must be tagged.
- O. Provide transient voltage and surge suppression for all workstations and panels either internally or as an external component.

3.10 CONTROL AND COMMUNICATION WIRING INSTALLATION

- A. General
 - 1. Where wiring specifications differ between Division 25 and other divisions, Division 25 shall take precedence when pertaining to 24V wiring and conduit. This includes all IO, comm, and serial networks.
 - 2. The requirements of this Section shall not supersede the requirements of code or of the AHJ.
 - 3. Ethernet and Fiber network requirements are to be governed by Div 26 and Div 27 requirements.
 - 4. Requirements and installation practices for conduit in the pour are to be governed by the Div 26, associated civil and concrete sections and any GC project requirements. DDC contractor assumes responsibility for all instances where required or elected.
 - 5. Underground conduit and wiring is only required where meters or alarm devices are necessarily located underground. Such wiring to be governed by associate spec sections and provided by respective trades.
 - 6. DDC contractor must appeal application discrepancies in writing to EOR for interpretation. Absence of appeal is considered to be 100% compliant wiring and therefore enforceable as such.
 - 7. 24V power and wiring may be run in same conduit however contractor assumes full responsibility for signal integrity at risk of rework.
 - 8. Do not run power wiring and signal or communication wiring in the same raceway or conduit in the following instances:
 - a. Valve power for valves over 2"
 - b. AHU damper power
 - c. All central plant and cooling tower applications
 - 9. All field wiring shall be properly labeled at each end for the following:
 - a. All central plant IO and comm
 - b. All AHU IO and comm
 - c. All terminal unit comm (no IO)
 - d. For radiant, trench convectors, and building pressurization dampers if controller is not directly accessible by the equipment it serves, all comm and IO must be tagged.
 - 10. Wiring and raceways for control communications and signaling shall be sized, selected and provided by the DDC Systems Contractor.
 - 11. Power-line communication is not acceptable.
 - 12. All control communication and signal wiring shall be installed as continuous lengths, if that length is commercially available.
 - 13. When required, terminal blocks in junction boxes shall be used to join wire lengths. There shall be no wire-to-wire splices between termination points.
 - 14. Terminate all control and/or interlock wiring.

15. Install wiring in UL listed raceway or conduit when located in unconcealed or inaccessible locations, locations subject to foot traffic in the normal course of building operations, locations where wires may be damaged including equipment rooms within 8 feet of floor, or as required by code or AHJ.
 - a. EMT conduit shall be used in the following applications.
 - 1) Garage
 - 2) Central plant
 - 3) Cooling towers
 - 4) AHU mechanical rooms
 - 5) Vertical façade dampers, where cable is not concealed in window fascia plate.
 - 6) Outdoor locations
 - 7) Rigid conduit is not necessary unless required by AHJ.
16. Garage conduit shall be EMT or in pour in all instances.
17. Garage conduit shall be routed to avoid damage by doing the following
 - a. Running in the pour is an option at contractor application discretion
 - b. Where exposed mount above 9ft to be out of reach.
 - c. Where exposed do not mount where exposed to traffic or damage such as:
 - 1) Walls or column faces exposed to car traffic
 - 2) Forklift traffic or cargo stacking/loading/unloading are to be completely avoided.
 - 3) Any entrance/exit driveway walls or ceilings are to be completely avoided
 - d. All exposed garage conduit routing subject approval by EOR and owner
18. Garage CO sensors do not require rigid conduit.
19. Low voltage control signal and IO wiring may be installed without conduit or raceway in concealed, protected, and accessible locations such as above suspended ceiling, in underfloor spaces or spaces requiring a ladder or lift to access.
 - a. Suspended/supported plenum rated cable may be used in the following applications:
 - 1) VAV boxes
 - 2) Thermostat wiring in walls
 - 3) Underfloor locations
 - 4) Inside Trench Convectors pans
 - 5) Building pressurization dampers, where cable is concealed in mullion or window fascia plate.
 - b. Suspended/supported plenum rated cable in above T-bar ceilings and in underfloor areas must be installed as follows:
 - 1) With ties or slip rings bundling runs or groupings of wiring at 6 ft intervals (+/- 1 ft).
 - 2) With ties or slip rings securing all wiring to duct or floor supports at 90-degree path runs.
 - 3) Laying wiring on the ground is acceptable so long as it is also cable or attached with slip rings to floor supports.
 - 4) This wiring is a permanent feature of the building and should not be mixed in with data cabling. Using the same cable trays as division 27 or any other computer network cabling is not acceptable as this will lead to confusion and issues in the future.
20. Tacking wire to top of duct with magnetic bridal rings is acceptable. Drilling zip ties fasteners into duct for securing wiring is not acceptable. Cable tying or using slip rings attaching wiring to duct supports is acceptable.
 - a. Where thermostat, comm or power wiring leaves top of duct, it must be routed in EMT conduit.
 - b. Thermostat wiring does not require conduit in walls.
 - c. Exception: if duct is viewable from above by an occupant standing in occupiable locations use EMT wiring.

21. In mechanical/electrical rooms EMT conduit is the only acceptable routing type for DDC wiring. No free-hung wiring regardless of cable trays is acceptable as it could easily be confused with Div 27 computer cabling in the future.
 22. Above hard lid ceilings EMT is the only acceptable routing type for DDC wiring. No free-hung wiring regardless of cable trays is acceptable as it could easily be confused with Div 27 computer cabling in the future.
 23. Flex conduit in lengths of 6ft or less for sensors in lieu or in conjunction with EMT conduit is acceptable.
 24. Hiding wiring under duct or pipe insulation is never an acceptable installation practice.
 25. EMT for DDC systems can (and where feasible should) follow the ducts or pipes it serves. Sharing supports with this equipment is acceptable.
 26. Seismic ratings of equipment cannot be compromised. DDC contractor to use discretion where conflicts could arise, seismic takes precedence.
 27. DDC contractor should never presume supporting acceptable bracketry will be provided by others. It is the sole responsibility of the Div 25 contractor to provide all anchors, trapeses, hangers, for a complete system.
 28. Clad or Jacketed Cable is not in conformance with the owners wiring standards and therefore not an acceptable substitute for EMT conduit.
 29. Do not install communication or signal wiring in raceway or enclosures containing high- or low-voltage power wiring.
 30. Junction boxes may be used for terminal blocks to join sections of wire where long pulls or pulls with many bends are necessary.
 31. Up to 4 bends and 150ft are allowable between wire pull sections.
 32. Run direct current signal wires separately from alternating current conductors. Where allowed by code, AC and DC wiring routes shall only cross at a 90-degree angle.
 33. DDC Contractor is fully responsible for noise immunity and for cost to rewire in conduit if electrical or RF noise affects performance.
 34. All temperature sensors on external walls shall have sealed handy boxes and foam backing plates to insulate the temperature sensor from drafts in the wall.
- B. All wiring shall be installed in a neat and workmanlike manner.
- C. Follow all manufacturers' installation recommendations.
- D. Wiring not in conduit shall be installed as follows:
1. Routed parallel or perpendicular to building and/or mechanical lines.
 2. Supported by or anchored as follows. Do not lay wiring on the ceiling.
 3. Wire that is not used for Ethernet, TCP/IP, or BACnet IP networking may be secured to structural members or to supports for ductwork, piping, and raceways.
 4. Wire that is used for Ethernet, TCP/IP, or BACnet IP networking (i.e. "category" cable) shall be supported from below by J-hooks, trays, or similar means. Do not kink or twist category cabling, and do not zip-tie it to its supports.
 5. Installed in sleeves where it passes through walls and floors. Maintain fire, smoke, envelope and pressure ratings of each space.
 6. All wire and cable installed in ceiling return plenums must be rated for plenum installation. If uncertain, contractor shall assume that above-ceiling spaces are plenums.
 7. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
 8. All wire-to-device connections shall be made at a terminal block or terminal strip.
 9. All wire to wire connections for power shall be at a terminal block. Communication wire shall be continuous, with no wire-to-wire connections.
 10. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- E. Shielding

1. Maintain continuous shielding of all communications and signal wiring.
 2. Shields shall be grounded only at controller or power source end and floated at other end, unless otherwise recommended by the controller manufacturer.
 3. Float shields through termination points, maintaining only on single grounding point and insulating from ground at all other points.
- F. Identification
1. Use color-coded conductors consistently throughout the entire DDC System installation.
 2. All field wiring shall be properly labeled at each end.
- G. Hardwire Interlocks:
1. High/Low discharge static pressure
 2. Low mixing plenum pressure
 3. Freeze-stats
 4. Cooling tower vibration switch
- H. Hardwire interlock by other trades:
1. Duct smoke detector
 2. Fire alarm system contact
 3. Kitchen ansul systems
 4. Any not specifically mentioned in DDC control drawings.
- I. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.
- J. The DDC Contractor shall verify integrity of all wiring to ensure continuity and freedom from shorts and grounds after the installation is complete. Communication wiring shall be tested to verify noise immunity and signal-to-noise ratio.

3.11 CONTROL AIR TUBING INSTALLATION

- A. General
1. Pneumatic tubing shall be sized by the DDC Contractor.
 2. All control air piping shall be installed in a neat and workmanlike manner parallel to building lines with adequate support.
 3. Piping above suspended ceilings shall be supported from or anchored to structural members. Tubing shall not be supported by or anchored to electrical raceways or ceiling support systems.
 4. Pneumatic tubing may be run in raceway containing electrical wiring.
 5. All pneumatic tubing shall be concealed in mech/elec rooms.
 6. Pneumatic tubing to follow all requirements of suspended wiring anywhere other 24V wiring is used. In those instances, EMT is not required.
- B. Installation methods and materials
1. Concealed and inaccessible: EMT conduit
 2. Concealed and accessible (including ceiling return air plenums): Use hard or soft copper tubing or FR plastic tubing, subject to the following limitations
 3. Splicing is acceptable. Use junction box or splice at pull boxes only when run in conduit.
 4. Copper tubing: Use only tool-made bends.
- C. Fittings and Sleeves
1. Where FR tubing exits the end of raceway or junction box, provide a snap-in nylon bushing. Where FR tubing exits control panels, provide bulkhead fittings.
 2. Where copper tubing exits junction boxes or panels, provide bulkhead fittings.
 3. Brass-barbed fittings shall be used at copper-to-FR tubing junctions. Plastic slipped over copper tubing is not acceptable.
 4. Sleeve through concrete surfaces in minimum 1-inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.

- D. Number-code or color-code tubing at each end for identification and servicing of control system. Code shall be as indicated on approved shop drawings.

3.12 TESTING AND COMMISSIONING

A. General

1. Perform tasks in the order outlined subject to direction of the General Contractor.
2. Notify the Commissioning Authority and the Engineer if jobsite circumstances, Project schedule, or General Contractor instructions require substantial deviation from this sequence of events.
3. Comply with Commissioning Requirements as specified in Division 1.
4. DDC Contractor shall provide a qualified technician who shall execute all Pre-Functional and Functional Tests in the presence of the Commissioning Authority.
5. All deficiencies identified shall be corrected and demonstrated to the Commissioning Authority after resolution for acceptance.
6. DDC Contractor shall fulfill all obligations as outlined in the Commissioning Plan including post occupancy/Warranty testing as deemed necessary by the Commissioning Authority.
7. Coordinate with Work specified in Sections 23 08 00 and 26 08 00.
8. Unless specifically prohibited by Owner, DDC Contractor shall provide remote access to DDC System for duration of commissioning process.
9. DDC Contractor shall set up a Commissioning User account with read-only access, including the ability to view all graphical pages and view and download trends.
10. Provide account login credentials to Engineer of Record and Commissioning Authority
11. Establish and verify account access prior to performing Functional Tests.

B. Test Forms

1. Pre-Functional/Point-to-Point Test Forms
2. DDC Contractor shall prepare forms to verify correct installation and document proper startup of the DDC System and its components.
3. Provide forms for all checks and tests
4. Each form shall be typewritten and have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
5. Test and Balance forms shall be provided by Test and Balance (TAB) Contractor. However, Setpoint Determination Report is the joint responsibility of TAB Contractor and DDC Contractor. DDC Contractor shall coordinate with TAB Contractor and submit a coordination plan including a copy of the TAB forms to be used in setpoint determination.
6. Functional Test procedures and associated forms shall be prepared by Commissioning Authority and shall be reviewed by Engineer of Record and Owner.
7. DDC Contractor shall review Functional Test requirements to understand the scope and level of effort required for the testing process.
8. Functional Tests procedures and associated forms shall be provided to DDC Contractor, after Submittal Package 2 has been reviewed and accepted.
9. DDC Contractor shall review tests and provide comments as follows:
10. If any proposed testing procedure risks damaging equipment or voiding equipment warranty, provide suggested alternative test procedure to avoid these concerns.
11. Recommend changes that will improve ease, accuracy or speed of testing.
12. Verify that proposed test procedures will generate the expected responses when tested against the specified Sequences of Operations. Identify any discrepancies between the apparent intent of the Sequences of Operations and the apparent intent of the associated test procedure.
13. Provide comments in digital format. Preferred format is Microsoft Word documents with Track Changes enabled.
14. DDC Contractor shall prepare Functional Tests procedures and associated forms, after Submittal Package 2 has been reviewed and accepted.

15. DDC Contractor shall prepare forms to verify correct execution of Sequences of Operations logic and correct operation of all alarms, interlocks, and schedules without compromising system integrity or damaging any piece of equipment.
 16. Provide forms for all checks and tests described.
 17. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
 18. All forms shall be provided in digital format.
- C. Pre-Functional and Point-to-Point Tests
1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 2. Ensure devices are properly installed with adequate clearance for maintenance.
 3. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in raceway.
 4. Verify that all sensor locations are as indicated on drawings and are away from heat sources and other causes of erratic operation.
- D. Electrical Checks
1. Verify integrity/safety of all electrical connections.
 2. Power to all controllers and actuators. Confirm emergency or uninterruptible power where specified.
 3. Verify that shielded cables are grounded only at one end.
 4. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 5. Check power supplies for proper voltage ranges and loading.
 6. Ensure that terminations are safe, secure and labeled
 7. Check for adequate grounding of all panels and devices.
- E. Perform the following tests for each central plant controller and for a sampling of all other controllers as determined by the Commissioning Authority:
1. Network Speed
 - a. Verify points are updated on front end with 10seconds.
 2. Comm interruption test
 - a. Disconnect comm from major equipment controller
 - b. Verify the event is annunciated at operator's interface and recorded in event log.
 3. Loss of Comm Operation
 - a. Disconnect controller from Primary or Secondary Control LAN.
 - b. Verify the event is annunciated at operator's interface and recorded in event log.
 - c. Verify that isolated controllers continue to perform normally
 4. Loss of Power
 - a. Disconnect controller from power source. Wait for 30 seconds, then reconnect power.
 - b. Verify that controller configuration and programming is retained, and that controllers resume function automatically
 5. For each controller, perform Point Verifications and Point-to-Point Tests
 6. Control Loops
 - a. For all loops, document P/I gains, tuning parameters, chosen setpoints, time delays, and loop execution speed in Pre-Functional Test report.
 7. Network Communication Tests
 - a. Verify adequate signal strength on all networks.
 - b. Verify that network wire runs do not exceed maximum length.
 - c. Verify a maximum of 25 nodes per trunk.
 - d. With all system and communications operating normally, perform the following network response tests.
 - 1) Tests shall be performed after trends have been set up and are operational.
 8. Alarm annunciation test

- a. Randomly select a device whose failure will generate a Level 1 or 2 alarm and manually shut it off.
 - b. The status points for the device must indicate the change of state of the device at the Operator Workstation within 10 seconds.
 - c. The test shall be repeated for four devices in each building.
9. Clock synchronization test
- a. Randomly select a controller on a Secondary Control LAN.
 - b. Compare that controller's clock signal to the system clock.
 - c. Test passes if sampled time signal is within 2 seconds of system clock time.
 - d. Test 5% of devices on Secondary Control LANs, minimum of three devices.
10. If the system fails any test, the system architecture shall be revised as required. Provide additional capacity (install more trend memory, more controllers with trend storage capability, network repeaters to allow an increase in network speed, etc.) and repeat tests.
11. Alarms and Interlocks:
- a. Test each software alarm separately. Record date and time, alarm description, action taken, or signal value sent to initiate the alarm, and observed response.
 - b. Verify alarm levels are correct per Sequences of Operations and this Section.
 - c. Confirm that each alarm is annunciated correctly
 - d. Confirm that each alarm is routed to appropriate devices and individuals
 - e. Test each hardware interlock separately.
 - f. Trip interlock using field (physical) contacts.
 - g. Verify appropriate equipment response including normal position of fail-safe actuators. Note position of each fail-safe actuator separately on test forms.
 - h. Coordinate with Division 26 to test fire and life safety systems alarm contacts and interlocks.
12. Determine the minimum speed for each variable frequency drive (VFD)
- a. Unless otherwise indicated, minimum speed for VFD-driven fans and pumps shall be the greater of 10% or the minimum required for visible motion.
13. User Interface Checks
- a. All user interface elements and graphics are functional.
 - b. Graphics are properly bound to physical devices or virtual points.
 - c. Links and page jumps are functional and logical.
 - d. Events and alarms are annunciated timely
14. Pre-Functional Test Report
- a. After submitted test forms have been accepted, DDC Contractor shall perform all listed tests, take corrective action as required for failed tests, and repeat tests until a passing condition is obtained.
 - b. Document results on forms and submit for approval as Pre-Functional Test report.
 - c. Point-to-point tests must be performed and documented **for every individual point** in the system. Testing a sample or subset of points shall not be acceptable. **The Pre-Functional Test report shall not be accepted, nor shall further work be authorized, until all point-to-point tests have been completed to the satisfaction of the Engineer of Record and Commissioning Authority.**
 - d. Report shall be word-searchable electronic format
 - e. All information on forms shall be typed. Hand-written forms, or typed forms with hand-written results, shall not be acceptable.

F. Test and Balance

- 1. Coordinate with Work performed under Division 23 Test and Balance (TAB). DDC Contractor shall support TAB Contractor in execution of tests that require interaction with or overrides of the DDC System.
- 2. Provide informal training of (1) hour to TAB contractor foreman and subordinate with the purpose of allowing them to navigate and adjust all hardware and software necessary to perform their scope autonomously.

3. After such informal trainings TAB contractor is expected to be completely responsible for disseminating that information to crew to execute work.
4. DDC contractor is not beholden to TAB contractor for limitless trainings.
5. DDC contractor is not expected to be present for routine balancing scope or on standby for balancing support.
6. TAB contractor to apply lessons learned in training to execute scope independently as possible.
7. Absence of DDC contractor availability for TAB contractor scope does not exempt TAB contractor from execution.
8. Note: while intent is for TAB contractor to be fully equipped to execute their scope, central plant will likely require a very coordinated effort.
9. Software shall be provided to TAB Contractor free of charge on at least a temporary basis to allow calibration of terminal box airflow controls and other Work specified under Division 23 TAB.
10. DDC Contractor shall loan TAB Contractor a POT or portable device with software installed for the duration of Work specified under Division 23 TAB.
11. Provide sufficient training to those performing Work specified under Division 23 TAB to allow them to use the software for balancing and airflow calibration purposes. Contractor shall provide a single training session for this purpose.

G. Setpoint Determination (as necessary)

1. Perform Pre-Functional Tests before performing setpoint determination.
2. TAB Contractor shall develop Setpoint Determination Plan to establish correct values for balancing for these parameters.
3. DDC Contractor shall review Setpoint Determination Plan to ensure that planned tests will provide information required to correctly program Sequences of Operations.
4. DDC Contractor shall supplement TAB contractor plan with any setpoints necessary to accomplish the sequence of operation.
5. DDC Contractor shall submit Setpoint Determination Report, which shall consist of the relevant subset of Test and Balance forms, documenting results of all tests and final setpoints determined. DDC Contractor shall use these values for initial BAS programming.
6. In Setpoint Determination Report, DDC Contractor shall flag any values that seem anomalous, outside of expected range, or otherwise problematic.
7. Submit report for approval before scheduling Functional Tests (as necessary)

H. Functional Tests (as necessary)

1. Functional Tests shall test all control logic in a formal manner to verify that Sequences of Operation were programmed accurately and provide the intended system behavior as tests internal to the DDC contractor. CxA or owner is not included, but may witness these tests.
2. If Functional Test procedures are prepared by others, DDC Contractor shall review tests and provide comments as follows:
 - a. If any proposed testing procedure risks damaging equipment or voiding equipment warranty, provide suggested alternative test procedure to avoid these concerns.
 - b. Recommend changes that will improve ease, accuracy or speed of testing.
 - c. Verify that proposed test procedures will generate the expected responses when tested against the specified Sequences of Operations. Identify any discrepancies between the apparent intent of the Sequences of Operations and the apparent intent of the associated test procedure.
3. Functional Test report shall not be performed until all required trend logs are set up and recording, and read-only remote access via the Commissioning User login account is available
4. Functional Tests performed in the absence of trends shall not be accepted for the following equipment:
 - a. AHU
 - b. EAHU

- c. Central Plant Equipment
- d. Note: terminal units exempt.
- 5. Each functional test shall consist of a series of defined steps.
 - a. For each step, test form shall include descriptions of an action/override to initiate the step and the expected system response.
 - b. For each step, technician performing test shall record actual system response and any notes or comments.
 - c. Expected response and actual response shall be described qualitatively (e.g. "fan speed increases") or quantitatively (e.g. "setpoint increases by 1.5°F") as appropriate.
 - d. Technician shall describe all observed responses. Where quantitative results are expected, technician shall record specific values observed. Simply checking "OK" or "PASSED" shall not be sufficient.
- 6. Functional tests shall verify at least the following:
 - 1) Equipment and occupancy schedules: Override system clock to verify equipment starts and stops on appropriate times/days.
 - 2) Equipment startup dependencies, sequencing (e.g. verify that HHW pump starts before boiler fires), and lockouts (e.g. verify that boiler will not fire if HHW pump is disabled): Override status points of triggering equipment and verify response of dependent equipment.
 - 3) Minimum on- and off-times: Override runtime counters and trigger events and verify that equipment remains running or remains stopped for appropriate period of time.
 - 4) Lead/lag staging: Override staging triggers (e.g. temperature readings, T&R Requests, calculated loads, etc.) and verify automatic start of lag equipment.
 - 5) Lead/standby staging: With system operating, disable lead equipment and verify that standby equipment starts automatically.
 - 6) Rotation: Override runtime counters and verify that lead device rotates as intended.
 - 7) All setpoint reset logic: Override resetting parameter (e.g. outdoor air temperature) and verify correct reset of setpoint.
 - b. For all Trim & Respond setpoint reset loops:
 - 1) Request generation: Override conditions at source of Requests (e.g. terminal unit or air handler) to verify that correct quantity and type of Request is generated. Verify that Requests are removed when override is removed.
 - 2) Setpoint reset: Override number of Requests seen by controlled equipment (e.g. air handler or plant) and verify correct reset of setpoint. Adjust number of responses to observe trimming, responding and holding of setpoint.
 - 3) Setpoint reset range: By adjusting Requests at controlled equipment, cause Trim & Respond loop to cycle setpoint from minimum value to maximum and then back to minimum. **Confirm that loop does not get "stuck" at either end of setpoint range.**
 - c. Correct handling of all failure conditions, including equipment failover and alarm notification: Override equipment to produce failure conditions and observe system response.
- 7. Testing schedule shall be coordinated with the Commissioning Authority and/or Commissioning Coordinator.
- 8. Functional tests may be witnessed by Owner's Representative at the Owner's option so long as it does not interfere with testing schedule. DDC Contractor is not required to schedule tests at Owner's convenience.
- 9. All accepted Functional Tests shall be conducted by the DDC Contractor with results confirmed and signed by the Contractor's technician.
- 10. Functional Test Report

- a. After submitted test forms and trends have been accepted, DDC Contractor shall perform all listed tests, take corrective action as required for failed tests, and repeat tests until a passing condition is obtained.
 - b. Document results on forms and submit for approval as Functional Test report.
 - c. All Functional Tests must be documented as passing by the Engineer of Record and Commissioning Authority before Demonstration Tests are scheduled.
 - d. Tests which are noted as passing but fail during demonstration (see below) shall incur additional costs to DDC Contractor, above and beyond cost of remediating failed test.
- I. Demonstration Tests (to contract authority or 3rd party commissioning agent as applicable)
1. Demonstration Tests are the final 3rd party CxA tests conducted in accordance with that spec section.
 2. Where CxA spec and Div 25 spec differ, the requirements of this spec to take precedence.
 3. Schedule the demonstration with the Commissioning Authority and Owner's Representative at least 2 weeks in advance.
 4. Demonstration Tests shall not be scheduled until the Functional Test report has been accepted.
 5. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc.
 6. Contractor-supplied personnel shall be those who conducted the Functional tests or who are otherwise competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems.
 7. The system will be demonstrated following procedures that are the same or similar to those used in the Pre-Functional and Functional Tests. The Commissioning Authority will supply the test forms.
 8. Demonstration tests shall be witnessed by Commissioning Authority. Demonstration tests undertaken without Commissioning Authority shall not be considered valid.
 9. Demonstration tests may be witnessed by Engineer of Record at the EOR's option.
 10. Demonstration tests may be witnessed by Owner's Representative at the Owner's option.
 11. Contractor shall conduct tests as directed by and in the presence of the Commissioning Authority and complete test forms. Completed forms shall be submitted as the Demonstration Test report to the Commissioning Authority after tests are complete.
- J. Remedial Work
1. Failed demonstration tests will require any remedial work at no additional cost to owner.
 2. DDC contractor to reimburse CxA at T&M for re-testing.
 3. Repair or replace defective Work, as directed by Owner's Representative in writing, at no additional cost to the Owner.
 4. Restore or replace damaged Work due to tests as directed by Owner's Representative in writing, at no additional cost to the Owner.
 5. Restore or replace damaged Work of others, due to tests, as directed by Owner's Representative in writing, at no additional cost to the Owner.
 6. Remedial Work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the Owner's Representative, at no additional cost to the Owner.
 7. It is possible that deficiencies in the trades of others can be uncovered through course of Div 25 commissioning. Such deficiencies to be corrected at the expense of the associated trade and compensation for troubleshooting, diagnosing and retesting on the part of the CxA and DDC contractor to be back charged to the offending trade.
 8. Contractor shall compensate Owner's Representatives, Commissioning Authority, and/or Engineer of Record on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review additional BAS trends beyond the initial tests, at no additional cost to the Owner.

3.13 TRAINING

- A. ***Include 16 hours total of on-site training*** to assist personnel in becoming familiar with site-specific issues, systems, Sequences of Operations, etc.
- B. Training Schedule
 - 1. Schedule training to provide Owner with at least 10 business days advance notice.
 - 2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays.
 - 3. Training shall be on site.
- C. Attendance Tracking
 - 1. Circulate sign-in sheet at beginning of each session and solicit attendees to sign/initial.
- D. Off-Site Primary/Factory System Training
 - 1. Factory training is not required.
- E. Regular Operators shall be trained to perform the following tasks:
 - 1. Understand control system architecture and configuration
 - 2. BMS Control system components
 - 3. Understand system operation and Sequences of Operations
 - 4. Operate the workstation and peripherals
 - 5. Log on and off the system
 - 6. Access graphics, point reports, and logs
 - 7. Adjust and change system set points, time schedules, and holiday schedules
 - 8. Understand and acknowledge alarms
 - 9. Understand system drawings, and Operation and Maintenance manual
 - 10. Understand the Project layout and location of control components
 - 11. Print reports
 - 12. Export trends
- F. Training Materials
 - 1. Present 1 hard copy of the approved submittals and as-builts as described above.
 - 2. Provide each attendee with a color hard copy of all training materials and visual presentations.
 - 3. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
 - 4. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

END OF SECTION

SECTION 25 9000
SEQUENCES OF OPERATION FOR HVAC DDC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes control logic sequences for DDC for HVAC systems, subsystems, and equipment.
- B. Related Requirements:

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 1. All Division 25, Division 23 specifications
 - 2. Note: Division 25 takes precedence (if discrepancies) exist with regard to DDC controls only.

1.03 Explanatory Notes

Throughout the sequences, text which appears italicized in boxes is intended to provide explanations and rationale for the control logic sequences. They are there for the benefit of the engineer and the controls contractor, but they are not themselves sequence logic and should not be programmed as such.

1.04 DEFINITIONS

- A. Industry Standard Definitions
 - 1. Analog Input (AI): Proportional signal from a sensor into a DDC controller (typically 0-10 VDC or 4-20 mA) to BMS.
 - 2. Analog Output (AO): Proportional command signal from a DDC controller to a device (typically 0-10 VDC or 4-20 mA) from BMS.
 - 3. Binary Input (BI): On/off or relay type signal into a DDC controller.
 - 4. Binary Output (BO): On/off or relay type signal from a DDC controller.
 - 5. BMS: Building Management System. Equivalent to Energy Management and Control System (BMS), Building Automation System (BAS), etc.
 - 6. DDC: Direct digital control, the control of building equipment by a programmable computer.
- B. Definitions Particular to this Specification
 - 1. Enabled/Disabled (for equipment): Indicates whether a piece of equipment is available to respond to a command (to run, or modulate, etc.) The statement "X is enabled" means that X is *available* to run but not necessarily running.
 - 2. Enabled/Disabled (for control loops): Indicates whether the control loop is actively calculating an error signal and is available to use for control. Disabled control loops are inactive; they do not accumulate error and they are not used for control.
 - 3. Mode: The dominant Operating Mode of an air handling unit (e.g. Occupied, Unoccupied, Warm-up, etc). Often scheduled but may be in response to building conditions.
 - 4. Occupied/Unoccupied: Refers to a zone (or collection of zones) that is scheduled for potential occupancy (or not). People may or may not be present.
 - 5. Populated/Unpopulated: Refers to a zone where people are currently present (or not), as indicated by occupancy sensor, CO₂ measurement, or other means.

1.05 DESCRIPTION

- 1. General: The control system shall be as shown and consist of a high-speed, peer-to-peer network of DDC controllers and an operator workstation residing and communicating on a

- BACnet internet work. Each mechanical system, building floor plan, and control device will be depicted by point-and-click graphics.
2. The control system shall be supplied with a complete web enabled package. The system shall support unlimited users using standard web browsers such as Chrome or Firefox. The web server software shall operate on standard industry PC servers. Proprietary servers or "black boxes" are not acceptable. Web browser software shall be manufactured by the control system manufacturer and shall have the same look and feel as the operating system. Third party web software is not acceptable.
 3. The system will provide for future expansion to include monitoring of the card access, fire alarm, and lighting control systems

PART 2 - PRODUCTS

2.01 Delta Controls

- A. Delta Controls by Delta Controls Partners established within a 70 mi radius of the jobsite withing the past three years.
- B. The Contractor shall use only products from the corresponding manufacturer and product line listed.
- C. The system shall connect to the existing Delta Controls System. New graphics shall be created at this server. The system shall be installed in to match the owner's standards including installation methods, graphic screens, programming, alarms, and historical trending to match the existing Delta Control System installed by Environmental Systems, Inc.
- D. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (e.g., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

PART 3 - EXECUTION

3.01 Information to be coordinated with the test & balance contractor

- A. Parameters Determined in Balancing
 1. Controls contractor shall receive from the balance contractor system parameters to be programmed in the BMS.
 2. Upon receipt of this information, the controls contractor shall update the report by flagging any parameters that seem anomalous, outside of expected range, or otherwise problematic.
 3. Engineer shall review and approve the updated report before these parameters are programmed in the control system.
- B. Air Handling Unit
 1. Minimum Fan Speeds for
 - a. Supply Fan
 - b. Return Fan (if applicable)
 - c. Relief Fan (if applicable)
 2. Return fan airflow differential
 - a. The approx. fan speed differential to achieve specified cfm differential.
 3. Supply fan speed setpoints
 - a. The speed that provides supply airflow equal to the design outdoor air with the economizer outdoor air damper fully open.

- b. The speed that provides supply airflow equal to the design heating airflow scheduled on drawings. If no heating airflow is provided on drawings, default to half of the maximum cooling speed.
- c. The speed that provides supply airflow equal to the design cooling airflow scheduled on drawings.
- 4. DP ranges for the air branches or risers they serve.
 - a. For each main duct, there will be a max and min flow (assuming terminal unit diversity) that corresponds to a DP.
 - b. These values need to be recorded and passed to the DDC contractor for incorporation into the pumping control logic.
- 5. Minimum outdoor air damper positions
 - a. The outdoor air damper position required to provide min outdoor air when the supply fan is at min speed.
 - b. The outdoor air damper position required to provide min outdoor air when the supply fan is at max speed.
 - c. The outdoor air damper position required to provide design outdoor air when the supply fan is at min speed.
 - d. The outdoor air damper position required to provide design outdoor air when the supply fan is at max speed.
- 6. Relief damper positions (for actuated relief dampers without fans)
 - a. The relief damper position that maintains a building pressure of 0.05" while the system is at min position (i.e. the economizer damper is positioned to provide min outdoor air while the supply fan is at min speed).
 - b. The relief damper position that maintains a building pressure of 0.05" while the economizer damper is fully open and the fan is at max speed.
- 7. Return fan speed differential (for Return Fan Control)
 - a. The speed differential between supply air and return air fans required to maintain building pressure at desired pressure (e.g. 0.05"), using a handheld sensor if a permanent sensor is not provided. All return fans that normally operate with the air handler should be on.

C. Air Source Heat Pump

- 1. DP ranges for the hydronic branches or riser they serve.
 - a. For each branch or riser, there will be a max and min flow (assuming valve diversity) that corresponds to a DP reading.
 - b. These values need to be recorded and passed to the DDC contractor for incorporation into the pumping control logic.

D. EF - Temperature Controlled

- 1. The speed which provides the exhaust airflow rate scheduled on the plans.

E. EF - Schedule Controlled

- 1. The speed which provides the exhaust airflow rate scheduled on the plans.

F. EF - Occupancy Controlled

- 1. The speed which provides the exhaust airflow rate scheduled on the plans.

G. EF - Specialty Controlled

- 1. The speed which provides the exhaust airflow rate scheduled on the plans.

3.02 Sequences Of Operations

A. General

1. Contractor Review of Sequences

- a. EOR is bound by code to define the intended physical function of the equipment as it was designed for proper functionality. Not being an authorized distributor or practitioner of a DDC product, it is unfeasible for the EOR to provide written

descriptions for every digital detail necessary to execute the sequence of operations down to the keystroke. Where programming provisions are provided in this document, they are done so conceptually, not to be interpreted as literal as an operations manual. It is the responsibility of the applications engineering team and professional programmers within the DDC contractor's firm to apply the concepts stated in this sequence of operations and make use of the tools, features, and digital skillset afforded them to achieve the end effect. It is well recognized that many products can achieve satisfactory and even exemplary results in unique ways. Should complications or questions arise, the RFI and Submittal process shall suffice for resolution.

- b. As part of the controls submittal process, the DDC Contractor shall formally state "The sequences shall be programmed as written" or it shall describe any deviations. In particular, the contractor shall annotate any:
 - 1) Apparent errors in the sequence logic
 - 2) Control logic which might lead to equipment damage or violate manufacturer warranties
 - 3) Control logic elements which cannot be implemented due to the equipment submitted on by others.
 - 4) Limitations due to VE, phasing, or owner requirements which could conflict with the design intent on the contract documents.
2. Sequence modifications due to equipment or OEM controls limitations
- a. Typically, the equipment specified is open to competition and as a result, there can be slight variations among various manufacturers that may impact the sequence of operations. It is common for there to be with limitations of OEM controls or slight discrepancies in the points provided.
 - b. If minor specifics of the OEM controls differ slightly but still meet the design intent, then the following applies:
 - 1) Network architecture, where provided by the EOR takes precedence over specific points. Substations of serial network comm where ethernet is designed is not acceptable. Note: topology variations through use of routers/repeaters/servers or mfr specific network products to best suit project conditions are the means and methods of the DDC contractor.
 - 2) Specified precision or particular attributes of OEM sensors may be relaxed or amended on limited, case by case basis to accommodate what the factory feels is best to run their equipment.
 - 3) The absence of sensors whose function is vital to the execution of the sequence of operations is not considered acceptable. Contractor to provide additional DDC controller to supplement the OEM controls if required to execute the sequence. This is particularly applicable for:
 - a) Central plant equipment, air source heat pumps, and all associated CHW & HHW pumps.
 - b) AHU, ERV.
 - 4) This must be brought the attention of the EOR during submittal process so that it can be properly approved.
 - 5) Approved changes need to be incorporated into the as-builts as the final sequence of operations. Functional and performance tests are then to be an accurate reflection of the OEM controls sequence as implemented for this specific project.
3. Zone Groups
- a. As a default, the zone groups are defined by the mechanical ductwork. Parent equipment and associated terminal units shall all grouped together.
 - b. The owner may have need to subdivide zones based on occupancy, tenants, space usage, etc. Example: a kitchen or lobby could have a collection of terminal units that need to be their own zone group.

- c. DDC Contractor shall submit zone groupings for owner approval as part of the submittal process.
 - d. Each Zone Group shall be capable of having separate occupancy schedules and Operating Modes from other Zone Groups.
 - e. Each zone served by a fan-coil or single-zone air handler shall be its own Zone Group.
 - f. All networking closets, mechanical and electrical rooms served by the air handler shall be a single Zone Group.
 - g. VRF or VRV FCU may be in groups or considered independent. Contractor to send RFI if the nature of the branch selector or CU is not clear.
 - h. Operable & manual window groups or natural ventilation zones may or may not coincide with mechanical equipment. Contractor to send RFI for all instances for proper verification of priority and overlap.
4. Building Operating Modes
- a. Occupied Mode:
 - 1) This is set based on user adjustable schedule.
 - 2) A thermostat with an override input may initiate occupied mode outside of the pre-set schedule.
 - 3) Schedule shall accommodate user provided holidays.
 - b. Morning Warm-Up Mode:
 - 1) The design intent is for the BMS to begin warming the building so that it can be comfortable at the start of occupied mode.
 - 2) 100% recirculation air (no outside air) is an acceptable method of warming the building efficiently when the building is unpopulated.
 - 3) The start time of warmup mode is initiated by user provided schedule.
 - 4) Zones where the window switch indicates that a window is open shall be ignored.
 - 5) During morning warm up, set all zone setpoints to initial setpoint of 76°F (adj) OR an alternative approach is to set all terminal unit dampers to full open.
 - 6) Enable the AHU and HHW plant to run.
 - 7) Allow economizer(s) to provide for 100% recirculation air if OAT < RAT.
 - c. Morning Cool-Down Mode:
 - 1) The design intent is for the BMS to begin cooling the building so that it can be comfortable at the start of occupied mode.
 - 2) 100% recirculation air (no outside air) is an acceptable method of warming the building efficiently when the building is unpopulated.
 - 3) The start time of warmup mode is initiated by user provided schedule.
 - 4) Zones where the window switch indicates that a window is open shall be ignored.
 - 5) During cool down mode, set all zone setpoints to initial setpoint of 69°F (adj) OR an alternative approach is to set all terminal unit dampers to full open.
 - 6) Enable the AHU and CHW plant to run.
 - 7) Allow economizer(s) to provide for 100% recirculation air if OAT > RAT.
 - d. Freeze Protection Mode (as applicable):
 - 1) During Unoccupied Mode, if any single zone falls below 38°F, the Zone Group shall enter Morning Warm-Up Mode until all zones are above 45°F.
 - e. Night Flush Mode (as applicable):
 - 1) The design intent is for the BMS to begin cooling the building so that it can be comfortable at the start of occupied mode.
 - 2) This mode will run to a manually schedule set by the owner and enabled for operation automatically by the BMS. Full sequence details of building cooling anticipation is described elsewhere in this sequence.
 - 3) 100% outside is to be used to pre-cool the thermal mass of the building. CHW or mechanical cooling equipment to remain locked out.

- 4) Air side equipment with access to outside air to run a fan best efficiency point as described on the mfr submittal data.
- 5) All terminal units to open to full position.
- 6) All zones intended to benefit from this sequence to be given an initial setpoint of 65°F (adj).
- 7) When all night flush participating zones have achieved their target setpoint for 2 hours (adj) then night flush is completed and all equipment can return to normal unoccupied mode.

f. Night setback mode:

- 1) Off-business hours based on user provided schedule.
- 2) The unit will run at relaxed setpoints as the expectation is that afterhours staff (shipping/receiving, janitorial, stocking) will have jackets or other non-business attire. Typical zone setpoints of 72°F should have 10°F (adj) added/subtracted from occupied mode setpoints. SF & RF to run as normal.

g. Unoccupied Mode:

- 1) When the Zone Group is not in any other mode.
- 2) For the purposes of this document, Unoccupied Mode assumes the building is unpopulated AND it is favorable for the maximum amount of equipment to be off. This is true for the majority of buildings in milder climates such as Ashrae climate zone 1.
- 3) However, for many buildings, unoccupied mode may need to be essentially like occupied mode with very relaxed setpoints. This is particularly relevant in extreme climates or where central plant sizing does not lend itself to quick morning warm-up or cool-down times.
 - a) Example: the weekend setpoints in Alaska over the weekend may need to be set to 45°F to prevent freeze related damage, and so that the morning warmup mode has a chance to function as intended.
 - b) Example: a large radiant slab may need more than 18 hours to reach temperature if it drifts too far over a holiday shut down. This system either needs to have an unoccupied setpoint (that is perhaps based on it being unpopulated) or it may need to enter occupied mode on a different schedule than the rest of the building to address this.
- 4) For clarification purposes with regard to this project: Unoccupied Mode is intended to refer to a mode where equipment may be safely turned off fully. DDC contractor to use discretion and apply sequences as required.

5. Control Loops

- a. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up.
- b. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a Neutral value.
- c. A control loop in Neutral shall correspond to a condition that applies the minimum control effect, i.e. valves/dampers closed, VFDs at minimum speed, etc.
- d. The term “control loop” or “loop” is used generically for all control loops. These will typically be PI loops. Proportional plus integral plus derivative gains are not required on all loops. Do not use the derivative term on any loops unless field tuning is not possible without it.
- e. Unless specifically indicated otherwise, the following guidelines shall be followed:
- f. To avoid abrupt changes in equipment operation, the output of every control loop shall be limited by a user adjustable maximum rate of change, with a default of 25% per minute.
- g. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar

numbers shall not be embedded in programs except for physical constants and conversion factors.

- h. All hardware points, not just inputs, should be capable of being overridden for purposes of testing and commissioning. For example, the commissioning agent should be able to command damper positions, valve positions, fan speeds, etc. directly through BMS overrides.

6. Trim & Respond (T&R) Setpoint Reset Logic

- a. Every DDC system on the market has a unique approach to this industry standard feature. This section is intended to serve a generic explanation of the effect it achieves. While DDC product specific features differ, they must achieve the reset effect and provide sufficient tunability to provide reliable functionality.
- b. Trim & Respond setpoint reset logic and zone/system reset Requests where referenced in sequences shall be implemented as described below.
- c. A “Request” is a call to reset a supply pressure or supply temperature setpoint. These are typically generated by equipment downstream of central service equipment; such as terminal units requesting pressure from an AHU supply fan.
- d. For each type of request, there must be complimentary variables to augment its use.
 - 1) Requests can be amplified or negated with an Importance Multiplier. Multiply the number of Requests by the Importance Multiplier and send to the system/plant that serves the zone/system. A value of zero causes the requests from that zone or system to be ignored. A value greater than one can be used to effectively increase the number of requests from the zone/system based on the critical nature of the spaces served. Importance Multiplier (default = 1)
 - 2) Request-Hours accumulates the integral of requests (prior to adjustment of Importance Multiplier) to help identify zones/systems that are driving the reset logic. Rogue zone identification is particularly critical in this context, since a single rogue zone can keep the Trim & Response loop at maximum, and prevent it from saving any energy.
 - 3) Request-Hours. Every x minutes (default 5 minutes), add x/60 times the current number of Requests to this request-hours accumulator point. The request-hours point is reset to zero upon a global command from the system/plant serving the zone/system – this global point simultaneously resets the request-hours point for all zones/systems served by this system/plant.
 - 4) Cumulative%-Request-Hours. This is the zone/system Request Hours divided by the zone/system run-hours (the hours in any Mode other than Unoccupied Mode) since the last reset, expressed as a percentage.
- e. For each upstream system or plant setpoint being controlled by a T&R loop, define the following variables. Initial values are defined in system/plant sequences below. Values for trim, respond, time step, etc. shall be tuned to provide stable control.
- f. Trim & Respond logic shall reset setpoint within a range SP_{min} to SP_{max} . When the associated device (e.g. fan, pump) is off, the setpoint shall be SP_0 . The reset logic shall be active while the associated device is proven on, starting Td after initial device start command. When active, every time step T, trim the setpoint by SP_{trim} . If there are more than I Requests, respond by changing the setpoint by $SP_{res} * (R-I)$, (i.e. the number of Requests minus the number of Ignored Requests), but no more than $SP_{res-max}$. In other words, every time step T:

Change setpoint by SP_{trim}

If $R > I$, also change setpoint by $(R-I) * SP_{res}$ but no larger than $SP_{res-max}$

- g. Where multiple DP sensors are placed in the system, requests shall be aggregated according to the DP they are associated with.

- 1) Example, if a building has East and West risers, these would have requests that correspond to different exposures. It would not make sense to reset the West wing DP based on requests made by the East wing, or vice versa.
- 2) DDC contractor to create T&R logic for each resettable setpoint, then use comparator logic so that the highest output of those logic sets shall be mapped to the equipment providing service (supply fan, pump, etc).
- 3) Note: each of these branch or riser setpoint ranges need to be determined by the air and water balancer as they will all be unique. Example: a roof of multiple AHUs with very high gpm rates could span 5-20 psi while a lobby radiant manifold that also has to be served would only require 3-8psi. These will run at very different times for very different reasons, the requests of each type need to be correctly applied to their respective ranges.

The following is an example of narrative sequence language that uses Trim & Respond to control the static pressure setpoint of a VAV AHU serving multiple downstream zones:

Static pressure setpoint shall be reset using trim and respond logic within the range 0.15 inches to 1.5 inches. When fan starts, setpoint is 0.5 inches. After fan is proven on for 5 minutes, every 2 minutes, decrease the setpoint by 0.04 inches. If there are more than two pressure requests, increase the setpoint by 0.06 for each request in excess of two, up to a maximum of 0.15. A pressure request is generated when any VAV damper served by the system is more than 95% open until the damper is less than 85% open.

(Note that in practice, it is not necessary to provide a narrative description like the one above when using T&R in sequences. Just provide the table of variables as shown below, along with a reference to the logic in this section. The narrative was provided in this example for illustrative purposes only, to show how common narrative logic maps to the table of variables.)

This sequence defines the T&R variables as follows:

Variable	Definition
Device	Supply Fan
SP ₀	0.5
SP _{min}	0.15
SP _{max}	1.50
T _d	5
T	2
I	2
SP _{trim}	-0.04
SP _{res}	0.06
SP _{res-max}	0.15

Description of general operation:

Starting 5 minutes after the fan status indicates the supply fan is on, the sequence will slowly reduce the AHU's static pressure setpoint by 0.04" every 2 minutes. As static pressure drops, downstream VAV box dampers will open further for a given load. When the combination of reduced static pressure and changes

in load drives more than two VAV boxes more than 95% open, the system will respond by increasing static pressure setpoint by 0.06" for every request, but no more than a maximum of 0.15" regardless of the number of requests. The setpoint will continue to increase every 2 minutes until all but 2 VAV boxes (for Ignore value of 2) are satisfied (damper position < 85%). Subsequently, the setpoint will continue to decrease by 0.04" every 2 minutes.

Example:

System starts at 11:55. Initial Setpoint is 0.5". At 12:00 (T_d after start time) the reset begins.

At 12:02 (i.e. $1 * T$ after reset begins), there is one request (i.e. $R=1$). Setpoint is reduced by SP_{trim} which is 0.04; since $R < 0$, there is no response. Net result: Setpoint is 0.46".

At 12:04 (i.e. $2 * T$), there are two requests (i.e. $R=2$): Setpoint is reduced by 0.04; since $R - I = 0$, there is no response. Net result: Setpoint is 0.42".

At 12:06 (i.e. $3 * T$), there are three requests (i.e. $R=3$): Setpoint is reduced by 0.04; since $R - I = 1$, response increases Setpoint by 0.06 (i.e. $1 * SP_{res}$). Net result: Setpoint is 0.44" (i.e. +0.02" net change).

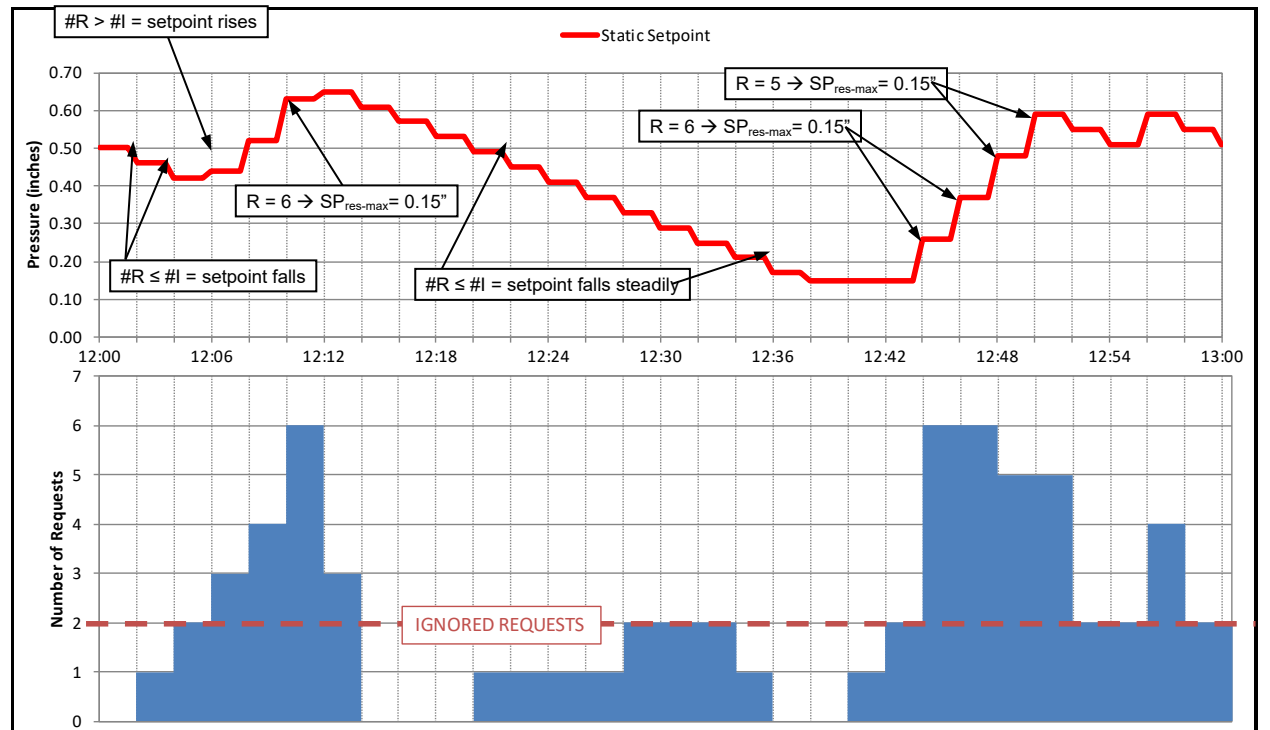
At 12:08 (i.e. $4 * T$), there are four requests (i.e. $R=4$): Setpoint is reduced by 0.04; since $R - I = 2$, response increases Setpoint by 0.12 (i.e. $2 * SP_{res}$). Net result: Setpoint is 0.52" (i.e. +0.08" net change).

At 12:10 (i.e. $5 * T$), there are six requests (i.e. $R=6$): Setpoint is reduced by 0.04; since $R - I = 4$ but $SP_{res-max} = 0.15$, response increases Setpoint by the maximum of 0.15 (i.e. not $4 * SP_{res} = 0.24$). Net result: Setpoint is 0.63" (i.e. +0.11" net change).

At 12:12 (i.e. $6 * T$), there are three requests (i.e. $R=3$): Setpoint is reduced by 0.04; since $R - I = 1$, response increases Setpoint by 0.06 (i.e. $1 * SP_{res}$). Net result: Setpoint is 0.65".

At 12:14 (i.e. $7 * T$), there are zero requests (i.e. $R=0$): Setpoint is reduced by 0.04; since $R - I < 0$, there is no response. Net result: Setpoint is 0.61".

This is a trend graph of the example above, continued for a period of an hour:



The system will tend towards minimum static pressure (thus saving energy) but respond rapidly to increasing demand from the terminal units. A cyclic pattern is characteristic of a robust Trim & Respond loop – the setpoint is not expected to remain static except at its minimum and maximum values. Note that this diagram was created for purposes of illustrating how requests are used to reset the setpoint and does not necessarily represent the expected behavior of an actual Trim & Respond loop, although the long, slow cycling of the setpoint value is typical of T&R control..

7. Alarms

- a. Levels of alarm in order of priority
 - 1) Level 1: Critical/life safety
 - 2) Level 2: Significant equipment failure
 - 3) Level 3: Non-critical equipment failure/operation
 - 4) Level 4: Energy conservation monitor
 - 5) Level 5: Maintenance indication, notification
- b. Note: these levels are a default starting point. Owner's may have a pre-existing protocol for annunciation and escalation. These take precedence in all instances.
- c. All alarms generated by the BMS shall include at least the following information:
 - 1) Date and time of the alarm
 - 2) Level of the alarm
 - 3) Description of the alarm
 - 4) Equipment tags for the units in alarm
 - 5) Possible causes of the alarm, if provided by the fault detection routines
 - 6) The Source which serves the equipment in alarm

8. Outdoor Air Temperature Sensing

- a. When there are multiple outdoor air temperature sensors, the system shall use the valid sensor that most accurately represents the outdoor air conditions at the equipment being controlled.
 - 1) Outdoor air temperature sensors at air handler outdoor air intakes shall be considered valid only when the supply fan is proven on and unit is in Occupied Mode or any other Mode in which the economizer is enabled.
 - 2) The outdoor air temperature used for graphics display, optimum start, plant lockout, and other global sequences shall be the average of all valid sensor readings. If there are four or more valid outdoor air temperature sensors, discard the highest and lowest temperature readings.
 - 3) If the control drawings indicate a weather station is to be provided, this is to be used as a global point that will be passed as a virtual point to all equipment. Note: this global point would not take the place of a hardwired OAT sensor being used to control an economizer. The weather station shall be displayed on the front end and trended on 15 min intervals. These trends to be auto-exported monthly in .csv format to the email of an admin user.

9. Equipment Staging and Rotation

- a. Automatic Even Wear Rotation
 - 1) The automatic even wear rotation presented in the following section is written using the basis of equipment run time to determine position in the queue for staging and is triggered only during a stage up or stage down event. These sequences will provide the most even run time across multiple pieces of equipment.
 - 2) Lead/lag: Unless otherwise noted, parallel staged devices (such as pumps, towers) that are not redundant shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device.
 - 3) For example, assuming there are three devices, if all three are off or all are on, the staging order will simply be based on run hours from lowest to highest. If two devices are on, the one with the most hours will be set to be stage 2

- while the other is set to stage 1; this may be the reverse of the operating order when the devices were started. If two devices are off, the one with the most hours will be set to be stage 3 while the other is set to stage 2; this may be the reverse of the operating order when the devices were stopped.
- 4) Lead/standby: Unless otherwise noted, parallel devices (such as pumps, towers) that are 100% redundant shall be lead/standby alternated when more than one is off so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device.
 - 5) For example, assuming there are three devices, if all three are off, the staging order will be based on run hours from lowest to highest. If devices run continuously, lead/standby shall switch at an operator-specified runtime; standby device shall first be started and proven on before former lead device is changed to standby and shut off.
- b. Exceptions
- 1) Operators with appropriate access level shall be able to manually command staging order via software points overriding the Even Wear or Periodic Rotation logic above, but not overriding the In Alarm or Hand Operation logic below.
 - 2) In Alarm: If the lead device has a fault condition or has been manually switched off, a Level 2 alarm shall be generated and the device shall be set to the last stage position in the lead/lag order until alarm is reset by operator. Staging position of remaining devices shall follow the prevailing (Even Wear or Periodic Rotation) logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm. Fault conditions include the following:
 - a) Variable Speed Fans and Pumps
 - (1) VFD critical fault is ON
 - (2) Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the device is commanded on, or
 - (3) Supervised HOA at control panel in OFF position, or
 - (4) Loss of power (e.g. VFD DC Bus voltage = zero)
 - b) Constant Speed Fans and Pumps
 - (5) Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the device is commanded on, or
 - (6) Supervised HOA at control panel in OFF position
 - c) ASHPs
 - (7) ASHP alarm contact, or
 - (8) ASHP is manually shut off as indicated by the status of the Local/Auto switch from ASHP gateway, or
 - (9) ASHP status remains off 5 minutes after command to start
 - 3) Hand Operation: If a device is on in Hand (e.g. via an HOA switch or local control of VFD), the device shall be set to the lead device and a Level 4 alarm shall be generated. The device will remain as lead until the alarm is reset by the operator. Hand operation is determined by
 - a) Variable Speed Fans and Pumps
 - (10) Status point not matching its on/off point for 15 seconds while the device is commanded off

- (11) VFD in local "hand" mode
 - (12) Supervised HOA at control panel in ON position
 - b) Constant Speed Fans and Pumps
 - (13) Status point not matching its on/off point for 15 seconds while the device is commanded off
 - (14) Supervised HOA at control panel in ON position
 - c) ASHPs: ASHP is manually turned on as indicated by the status of the local/auto switch from ASHP gateway.
10. Maintenance / Service Modes
- a. Applicable for all staged, and rotated equipment serving common pipes or ducts including but not limited to fans in fan wall, AHU's with common main ducts and isolation dampers, pump headered in parallel, ASHPs in parallel, redundant fan coils in parallel, exhaust fans with common mains and isolation dampers, lab exhaust fans, and any other N+1 redundant equipment.
 - b. The need for equipment service will inevitably arise when a fan, pump, ASHP, etc. which is part of rotation of devices will need to be disabled for service.
 - c. The DDC contractor shall provide programming to allow an operator to disable a piece of rotating equipment without interrupting the sequence of operation.
 - d. Example if three pumps are staged to provide full rated flow, any one of them must be able to disabled without reprogramming or other manipulations.
 - e. Note: this not intended guarantee the continuity of service, the loss of a pump or ASHP is likely to have consequences. Controls cannot provide redundancy, it must have been part of the original design. The intend is just to allow operators to safe off equipment while the remainder of the system is left in automatic control and is still attempting to execute the sequence to the best extent it can.
11. Air Economizer High Limits
- a. Economizer shall be disabled whenever the outdoor air conditions exceed the economizer high limit setpoint as specified by local code. Setpoints vary by energy standard, climate zone, and economizer high limit control device type. Setpoints listed below are for current ASHRAE and California Energy Standards.
 - b. Title 24-2013:
- | Device Type | California Climate Zones | Required High Limit (Economizer Off When): |
|-----------------------|--------------------------|--|
| Differential Dry Bulb | 1, 3, 5, 11-16 | $T_{OA} > T_{RA}$ |
| | 2, 4, 10 | $T_{OA} > T_{RA} - 2^{\circ}\text{F}$ |
| | 6, 8, 9 | $T_{OA} > T_{RA} - 4^{\circ}\text{F}$ |
| | 7 | $T_{OA} > T_{RA} - 6^{\circ}\text{F}$ |
12. Damper/Valve Position
- a. Knowledge of damper and valve position are required for proper generation of Trim & Respond reset requests.
 - b. The following are acceptable methods for determining position:
 - 1) Analog actuator. Position may be assumed to be equal to AO signal sent to actuator.
 - 2) Floating actuator. Provide position feedback via analog input.
13. VFD Speed Points
- a. The speed analog output sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz and 100% speed corresponds to maximum speed configured in the VFD.

- b. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with the test and balance specifications. Controls contractor shall coordinate with balance contractor.
 - c. For each piece of equipment, the minimum speed shall be stored in a single BMS software point. In case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BMS.
14. Miscellaneous
- a. The term “proven” (i.e. “proven on”/ “proven off”) shall mean that the equipment’s measured feedback point matches the state set by the equipment’s command point.
 - b. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g. for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences.
- B. Generic Thermal Zones (Terminal Units)
- 1. Application
 - a. This section applies to all single zone systems and sub-zones of air handling systems, such as VAV boxes, fan-powered boxes, etc.
 - 2. Occupancy schedule
 - a. Control contractor to obtain in written occupancy schedules from the Owner for each zone group. The Owner must approve the final schedules prior to controls completion.
 - b. The default schedule shall be 8AM – 8PM.
 - 3. Outdoor Air Ventilation Requirements
 - a. The minimum outdoor airflow for each zone shall be scheduled on the drawings. This applies to Vocc-min and Varea-min.
 - b. For projects complying with California Title 24 Ventilation Standards:
 - 1) Vocc-min: Zone minimum outdoor airflow for occupants, per Title 24 prescribed CFM-per-occupant requirements.
 - 2) Varea-min: Zone minimum outdoor airflow for building area, per Title 24 prescribed CFM-per-ft2 requirements.
 - 4. Minimum Outdoor Air
 - a. For every zone that requires mechanical ventilation, the zone minimum outdoor airflows and setpoints shall be calculated depending on the governing standard or code for outdoor air requirements. Zones that do not require mechanical ventilation may disregard this section.
 - b. For compliance with California Title 24, outdoor air setpoints shall be calculated as follows:
 - 1) Note: also see zone ventilation requirements section.
 - 2) For each zone in Occupied Mode, calculate the zone minimum outdoor air setpoints, which are used at the AHU level for minimum outdoor air control.
 - a) Zone-Abs-OA-min is equal to
 - (15) Varea-min if the zone has a CO₂ sensor.
 - (16) Varea-min if the zone has an occupancy sensor and is unpopulated.
 - (17) Zero if the zone has a window switch and the window is open.
 - (18) Zone-Des-OA-min otherwise.
 - b) Zone-Des-OA-min is equal to
 - (19) Zero if the zone has a window switch and the window is open
 - (20) The larger of Varea-min and Vocc-min otherwise.

- c. CO₂ Setpoints
 - 1) Setpoints assume an ambient concentration of 400 ppm; if the system includes an ambient CO₂ sensor, subtract 400 from these setpoints and add the ambient CO₂ sensor reading.
5. Zone Temperature Setpoints
- a. Each zone shall have separate occupied and unoccupied heating and cooling setpoints.
 - b. The software shall prevent:
 - 1) The heating setpoint from exceeding the cooling setpoint minus 1°F (i.e. the minimum difference between heating and cooling setpoints shall be 1°F).
 - 2) The unoccupied heating setpoint from exceeding the occupied heating setpoint.
 - 3) The unoccupied cooling setpoint from being less than the occupied cooling setpoint.
 - c. Where the zone has a local setpoint adjustment knob/button
 - 1) The setpoint adjustment offsets established by the occupant shall be software points that are persistent (e.g. not reset daily), but the actual offset used in control logic shall be adjusted based on limits and modes as describe below.
 - 2) The adjustment shall be capable of being limited in software.
 - a) As a default, the active occupied cooling setpoint shall be limited between 72°F and 80°F.
 - b) As a default, the active occupied heating setpoint shall be limited between 65°F and 72°F.
 - 3) The active heating and cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic described above. If zone thermostat provides only a single setpoint adjustment, then the adjustment shall move both the active heating and cooling setpoints upwards or downwards by the same amount, within the limits described above.
 - 4) The adjustment shall only affect occupied setpoints in Occupied Mode, and shall have no impact on setpoints in all other modes.
6. Demand Limiting
- a. A final approved demand control strategy must be approved by the governing utility company before implementation; DDC contractor responsible for understanding the contents of such plan as it relates to the contract documents. DDC Contractor is responsible to check all contract documents including LEED checklist and Owner provided requirement to verify additional specifics concerning demand control for this project. In the event that discrepancies exist, Contract for RFI EOR or relevant governing body for clarification(s).
 - b. The system shall be capable of receiving demand limiting signals from the local utility. This section is a **sample** thermostat based reset only and should not be confused as being the final or complete demand strategy for this project. Demand control strategies outside of the BMS, such as lighting, could exist for this project by are not covered in this section.
 - c. Cooling Demand Limit Setpoint Adjustment: The active cooling setpoints for all zones shall be increased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this adjustment through the normal BMS user interface. Changes due to demand limits are not cumulative.
 - 1) At Demand Limit Level 1, increase setpoint by 1°F.
 - 2) At Demand Limit Level 2, increase setpoint by 2°F.
 - 3) At Demand Limit Level 3, increase setpoint by 4°F.
 - d. Heating Demand Limit Setpoint Adjustment: The active heating setpoints for all zones shall be decreased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this

adjustment through the normal BMS user interface. Changes due to demand limits are not cumulative.

- 1) At Demand Limit Level 1, decrease setpoint by 1°F.
 - 2) At Demand Limit Level 2, decrease setpoint by 2°F.
 - 3) At Demand Limit Level 3, decrease setpoint by 4°F.
- e. At the onset of demand limiting, the local setpoint adjustment value shall be frozen. Further adjustment of the setpoint by local controls shall be suspended for the duration of the demand limit event.
7. After Hours Local Override (as applicable, see plans or sensor spec for applications)
- a. When thermostat override buttons are depressed, the call for Occupied Mode operation shall be sent up to the Zone Group control for 60 minutes.
 - b. This is to be an optional feature subject for owner approval. This need not be applied to all thermostats, only those of the owner's choosing. If not specifically mentioned in the sequence of operations or elsewhere in the project documents, this is not a required feature.
8. Testing/Commissioning Overrides
- a. As applicable for the project commissioning needs, provide the ability to individually command all control outputs to demonstrate proper functionality.
 - b. This is not intended to create one time use software or programming. Typically a simple admin login would allow for all setpoint to be over-ridden for testing. This is an acceptable method to accomplish commissioning testing.
 - c. Fan Coil Unit examples:
 - 1) Force fan to full speed, min speed, max cool
 - 2) Force CHW valve full open/closed
 - 3) Force HHW valve full open/closed
9. VAV Box Controllable Minimum (as applicable)
- a. There is the potential for the VAV minimum cfm to be lower than what the VAV flow ring or DDC controller can measure. This is particularly common when demand control is in use and the area minimum cfm is lower than the cfm that the terminal unit can reliably measure.
 - b. For these instances, it is acceptable to use partial on/off control of the VAV sometimes referred to as time averaged control.
 - c. Over a 10min period, the average of the VAV on time should equal the scheduled cfm.
 - d. Example: if the controllable minimum is 200cfm and the box is meant to deliver 100cfm, the VAV could be in open at 200cfm for half the time in 10 min period so that the average cfm over 10 min is 100cfm.
 - e. Assistance of the TAB contractor may be required to determine what the controllable minimum of the VAV is if manufacturer data is not available.

C. AHU

1. General

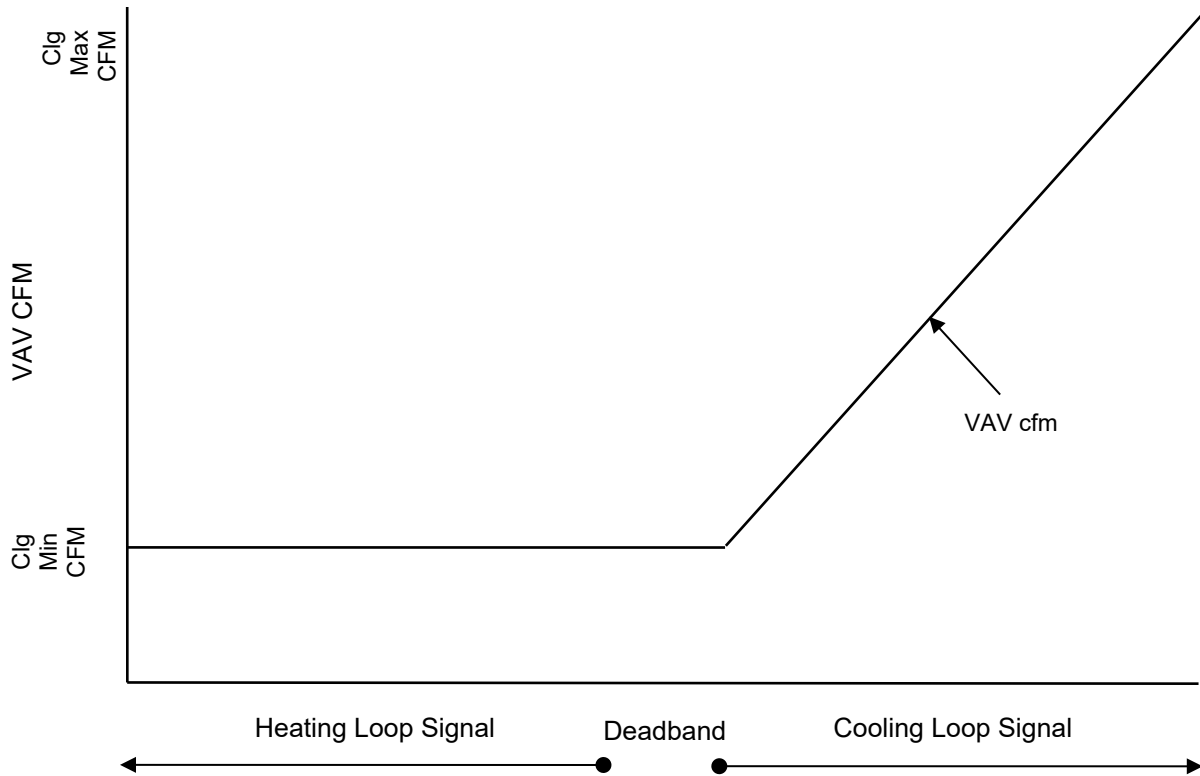
- a. This sequence provides a general outline for the correct selection of OEM controls from the equipment manufacturer. OEM control functions may vary slightly in their execution. All controls to be pre-wired at the factory and provided with a BACnet IP gateway.
- b. BMS is to integrate to the OEM controls to provide graphic representation of the equipment at the front end, annunciate all alarms, and to control the unit through setpoints.
- c. This is a standard VAV AHU that provides cooling air to VAV with reheat.

2. Modes

- a. In unoccupied mode the AHU is to remain off, with any coil valves closed and any OA or EA dampers closed.
- b. For morning warm-up, AHU will run with a supply air temp of 90°F (adj).

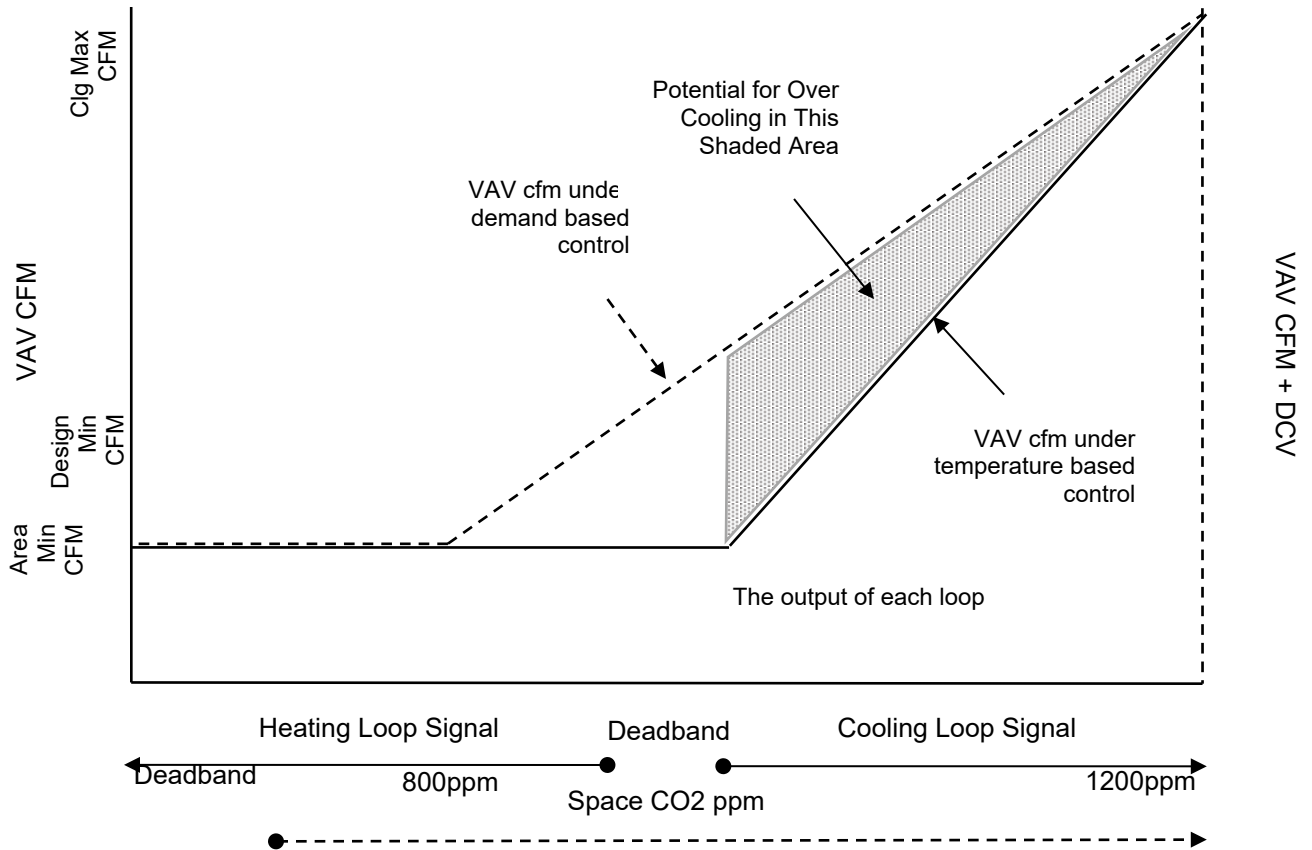
- c. In morning warm-up or cool-down, the AHU logic is the same as occupied mode with the exception being that OA & EA dampers may remain fully closed for 100% recirculation if conditions for heating/cooling are not favorable.
 - d. All other logic in this sequence pertains to occupied mode.
3. Supply Fan Control
- a. The supply fan will modulate with PI control to maintain a remote duct pressure setpoint.
 - b. All fans control in unison to single output signal.
 - c. Totalize current airflow rate from VAV boxes and display on AHU graphic.
 - d. Display the AHU AFMS airflow rate adjacent to the sum-of-zone airflow rate.
 - e. Note: high static switch is to be directly connected to emergency shut down input on supply fan(s) rather than rely on DDC logic.
4. Static Pressure Setpoint Reset
- a. DDC system shall pass the static pressure setpoint to the AHU through integration.
 - b. Design intent is for this pressure setpoint to gradually lower itself and be reset higher by requests from terminal units using trim and respond logic.
 - c. Example: the supply fan pressure setpoint will gradually lower itself in .1" w.c. (adj) increments about every 10 min (adj) unit dampers downstream start approaching maximum open position. At this point they will generate requests for more pressure and the AHU will need to then respond by lifting the pressure back up.
 - d. See terminal unit sequences for complete specifics how fan pressure requests are generated.
 - e. Suggested initial parameters for trim and respond are tabulated below. DDC Contractor responsible for tuning to provide stable operation. Seasonal tuning, if not explicitly stated elsewhere in the contract documents is outside the scope of this project.
5. Supply Air Temperature Control
- a. Use a PI loop to modulate the control valve to maintain discharge air temp at heating/cooling setpoint across the range of supply cfm. Controls contractor to provide tuning for stable operation.
6. Economizer Control
- a. Design intent is for OA and RA economizer dampers to modulate to allow for free cooling when conditions are favorable AND to maintain minimum outdoor air.
 - b. BMS to calculate the min OA required for each VAV zone in real time to capture the changes in flow resulting from demand control ventilation. These values are to be summed and passed to the AHU controller upon change of value.
 - c. The min OA control loop output is always to take priority over the free cooling loop.
 - d. The OA cfm feedback is measured by the OA AFMS, not based on a TAB setpoint.
 - e. When conditions are favorable for free cooling, the economizer shall modulate to maintain the mixed air averaging temp sensor (dry bulb only) at SAT setpoint minus 2°F (adj) but not at the expense of min OA.
 - f. Mixed air temp setpoint initially set equal to DAT setpoint minus 2°F (adj).
 - g. Favorable conditions are defined as:
 - 1) OAT \leq 75°F
 - 2) OAT < RAT
 - 3) OAT > 40°F (adj)
 - h. Outside Air Damper Lockout: If the outside air temperature is greater than the return air temperature, then modulate dampers to the minimum position.
7. Economizer – Other Modes
- a. Morning warmup mode or cool down mode (as applicable)
 - 1) This is schedule based and is set by the building owner.
 - 2) The building is assumed to be completely unpopulated which allows for 100% RA and 0% OA.

- 3) To expedite the warmup of the building (example: after a cold night), the OA dampers shall be fully closed for 100% recirculation so long as OAT < RAT
 - 4) To expedite the cool down of the building (example: after a hot weekend), the OA dampers shall be fully closed for 100% recirculation so long as OAT > RAT
 - b. Night flush mode
 - 1) This mode assumes night time OAT is suitable for cooling for approx. 2-4 hours.
 - 2) The schedule for this mode should be compared against OAT to be sure favorable conditions are present. Schedule based is set by the building owner.
 - 3) The building is assumed to be completely unpopulated.
 - 4) Command all associated terminal units to a thermostat setpoint of 60°F (adj). Without running the CHW plant, use 100% OA supply from the AHU to cool the zones. Same supply fan and return control logic from occupancy mode to be used.
8. Alarms
- a. Maintenance
 - 1) Interval alarm when fan has operated for more than 1,500 hours: Level 5. Reset interval counter when alarm is acknowledged.
 - 2) Annunciate any alarms available through integrations to heat wheel or fan wall OEM packages.
 - 3) Generate a maintenance alarm when the filter DP has exceeded threshold of .2' w.c. (adj).
 - b. Fans
 - 1) If the VFD is shut down by a high/low static switch, annunciate at the highest level alarm.
 - 2) If fan status or feedback does not match commanded setpoint for a period of 60 seconds, send alarm
 - 3) If building pressure is greater than .10", send alarm.
 - 4) If building pressure is less than .00" (negative), send alarm.
 - c. Filter
 - 1) If pressure drop exceeds alarm limit, send alarm.
 - d. Supply Air Temperature
 - 1) If supply air temperature exceeds 100°F or drops below 40°F, send alarm
9. Trends
- a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
 - 1) SAT and setpoint
 - 2) HHW & CHW valve position
 - 3) RAT, OAT
 - 4) OA CFM (as applicable, see controls diagrams)
 - 5) Supply Fan CFM, DP, DP setpoint (as applicable, see controls diagrams)
- D. VAV Cooling Only
- 1. General
 - a. Temperature control is standard cooling only VAV control where more air is delivered to the zone to keep temperatures from rising.
 - 2. These zones will be influenced by occupancy as determined through the lighting integration or hardwired occupancy sensors.
 - a. Per T24, any manual or automated windows in the zone must setback the cooling setpoint.
 - 3. Control Logic and Schematic
 - a. Control logic is depicted schematically in the figure below and described in the following sections.



- b. Figure above: The solid line axes correspond to cfm and temperature control.
- c. The design airflow setpoints for each zone shall be scheduled on the drawings for cooling max and cooling min.
- d. The VAV damper shall be modulated by a PI control loop to maintain the measured airflow at the active setpoint.
- e. When the zone is in cooling, the cooling loop output shall be mapped to the active airflow setpoint from the cooling minimum to the cooling maximum airflow setpoints to satisfy the zone.
- f. When the zone is in deadband or heating, the active airflow setpoint shall be the cooling minimum airflow setpoint.
- g. When lighting control system or occupancy sensors determine that the zone is unpopulated for more than 15min (adj), thermostat setpoints shall revert to relaxed values that are +/- 4°F (adj) from prior setpoint. If the AHU or overall building mode is in cooling, then 4°F added, if the AHU or overall building mode is in heating then 4°F subtracted. For VAV serving multiple spaces, occupancy must be off in all the associated zones.
- h. Open Window Setback per T24
 - 1) Refer to architectural plan for manually or automated operable windows.
 - 2) Per code, VAV serving multiple zones with multiple operable windows only need to have a window contact in the space with the thermostat. Note: there are instances where zones will have with multiple thermostats and this needs to be accounted for.
 - 3) Contact switches may be linked in series so that any open window triggers this sequence.
 - 4) Window status through software integration or hardwire contacts with an automated window control system is acceptable.
 - 5) When a window is proven open,

- a) If the space is in cooling then the space setpoint must be relaxed to 90°F.
 - b) If the space is in heating then the space setpoint must be relaxed to 55°F.
- 4. Alarms
 - a. Low airflow. If the measured airflow is less than 70% of setpoint while setpoint is greater than zero for 5 minutes, generate a Level 3 alarm.
 - b. Airflow sensor calibration. If the fan serving the zone has been off for 10 minutes and airflow sensor reading is above 20 CFM, generate a Level 3 alarm.
 - c. Leaking damper. If the damper position is 0% for 10 minutes and airflow sensor reading is above 50 CFM while the fan serving the zone is proven on, generate a Level 4 alarm.
- 5. System Requests
 - a. Air Pressure Requests
 - 1) If the damper position is greater than 85%, send 1 Request until the damper position is less than 75%,
 - 2) Else if the damper position is less than 75%, send 0 Requests
- 6. Trends
 - a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
 - 1) Discharge air temp & setpoint
 - 2) Damper position
 - 3) Cfm & cfm setpoint
 - 4) Space thermostat temp & setpoint
- E. VAV Cooling Only with CO2 / Demand Control
 - 1. General
 - a. This VAV will have 2 modes of operation: temperature-based control and demand based control.
 - b. Temperature control is standard cooling only VAV control where more air is delivered to the zone to keep temperatures from rising.
 - c. Demand control will deliver more air to the zone to influence the accumulation of space CO2 but is limited from overcooling by the space thermostat feedback.
 - d. Per T24, any manual or automated windows in the zone must setback the cooling setpoint.
 - 2. Control Logic and Schematic
 - a. Control logic is depicted schematically in the figure below and described in the following sections.



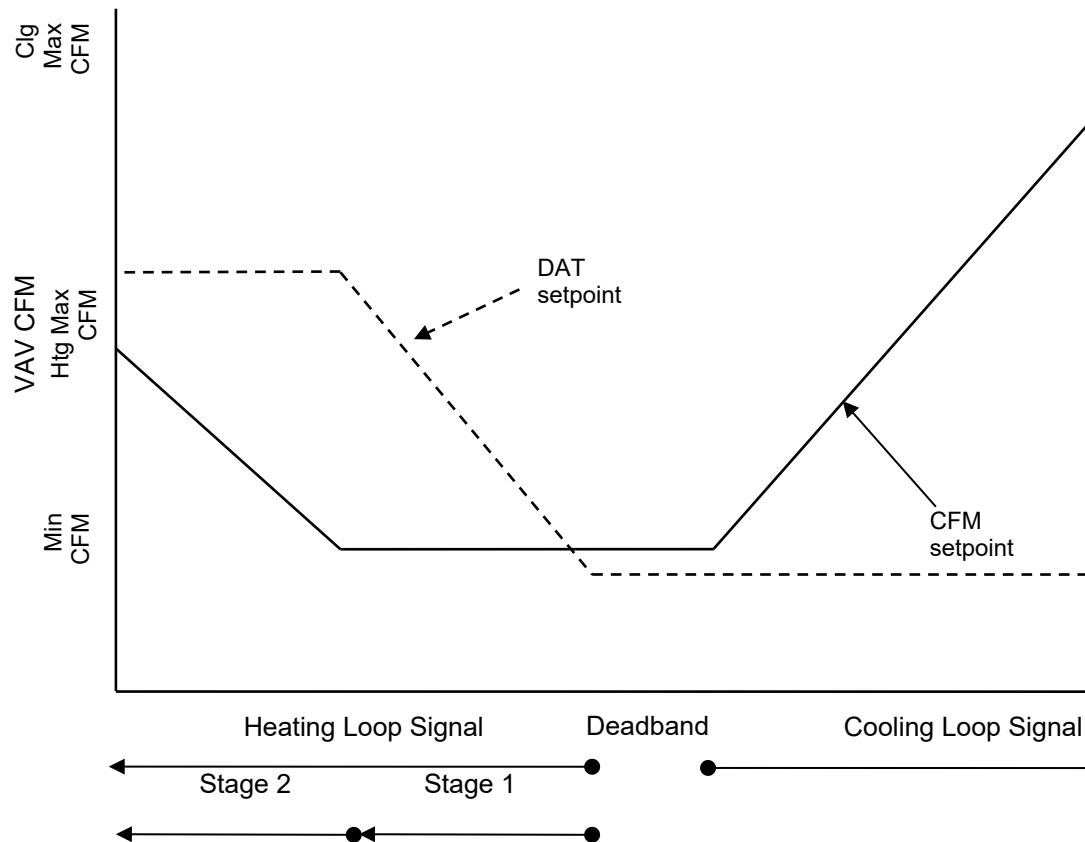
- b. Figure above: there are two y axes and two x axes on the graph above. The line style of the axis corresponds to the associated line on the graph. The solid line axes correspond to temperature only control. The dashed lines correspond to demand control with temperature limiting.
- c. The design airflow setpoints for each zone shall be scheduled on the drawings for cooling max and cooling min.
- d. The VAV damper shall be modulated by a PI control loop to maintain the measured airflow at the active setpoint.
- e. Temperature based control
 - 1) When the zone is in cooling, the cooling loop output shall be mapped to the active airflow setpoint from the area minimum to the cooling maximum airflow setpoints to satisfy the zone.
 - 2) When the zone in deadband or heating, the active airflow setpoint shall be the area minimum airflow setpoint.
- f. Demand based control
 - 1) This is the default state of the VAV in Occupied Mode. The zone is assumed to be unpopulated until space CO2 rises above a minimum threshold.
 - 2) In the unpopulated state, thermostat setpoints shall revert to relaxed values that are +/- 4°F (adj) from prior setpoint. If the AHU or overall building mode is in cooling, then 4°F added, if the AHU or overall building mode is in heating then 4°F subtracted.
 - 3) VAV cfm in the unpopulated state is reduced to the area min cfm as indicated on the drawings.
 - 4) If the space CO2 sensor detects 400ppm above ambient space CO2, VAV will release the relaxed setpoints from the unpopulated state.

- 5) The VAV will use a P-only loop mapped to the cfm setpoint of the VAV to influence the CO2 concentration. CFM is to ramp up as space CO2 increases. Associate the max VAV cooling cfm with 1000ppm.
 - g. Switching between temperature based and demand based control
 - 1) The potential for over or under cooling exists in demand based control.
 - 2) If a great deal of CO2 is present in the zone, then the associated increase in CFM has potential to over-cool the space. If the space thermostat falls to 68°F (adj) in demand mode, revert back to temperature control for 15 min (adj). At the end of 15 min, re-enable the demand based control as normal.
 - 3) If the zone is in an unpopulated state so that the supply cfm is at the area min, the potential for the zone to develop excessive heat exists. If the space thermostat rises above 76°F (adj) revert back to temperature control for 15 min (adj). At the end of 15 min, re-enable the demand based control as normal.
 - 4) In this way the zone can be influenced by both, without being overcome by either.
 - h. Open Window Setback per T24
 - 1) Refer to architectural plan for manually or automated operable windows.
 - 2) Per code, VAV serving multiple zones with multiple operable windows only need to have a window contact in the space with the thermostat. Note: there are instances where zones will have with multiple thermostats and this needs to be accounted for.
 - 3) Contact switches may be linked in series so that any open window triggers this sequence.
 - 4) Window status through software integration or hardwire contacts with an automated window control system is acceptable.
 - 5) When a window is proven open,
 - a) If the space is in cooling then the space setpoint must be relaxed to 90°F.
 - b) If the space is in heating then the space setpoint must be relaxed to 55°F.
3. Alarms
- a. Low airflow. If the measured airflow is less than 70% of setpoint while setpoint is greater than zero for 5 minutes, generate a Level 3 alarm.
 - b. Airflow sensor calibration. If the fan serving the zone has been off for 10 minutes and airflow sensor reading is above 20 CFM, generate a Level 3 alarm.
 - c. Leaking damper. If the damper position is 0% for 10 minutes and airflow sensor reading is above 50 CFM while the fan serving the zone is proven on, generate a Level 4 alarm.
4. System Requests
- a. Air Pressure Requests
 - 1) If the damper position is greater than 85%, send 1 request until the damper position is less than 75%
 - 2) Else if the damper position is less than 75%, send 0 requests
5. Trends
- a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
 - 1) Discharge air temp & setpoint
 - 2) Damper position
 - 3) Cfm & cfm setpoint
 - 4) Space thermostat temp & setpoint
 - 5) Space CO2 ppm & CO2 loop output %

F. VAV Reheat

1. General
 - a. In cooling the VAV will provide more cfm to satisfy the zone.
 - b. In heating the VAV will first raise the discharge air temp to try and satisfy the zone. If the zone continues to need additional heating the VAV will flow more cfm.
2. These zones will be influenced by occupancy as determined through the lighting integration or occupancy sensors.
 - a. Per T24, any manual or automated windows in the zone must setback the cooling and heating setpoint.
3. Control Logic and Schematic
 - a. Control logic is depicted schematically in the figure below and described in the following sections.

b.



- c.
- d. Figure above: there are two axes on the graph above. The line style of the axis corresponds to the associated line on the graph.
- e. The VAV damper shall be modulated by a PI control loop to maintain the cfm setpoint.
- f. The airflow setpoints for each zone shall be scheduled on the drawings for cooling max, heating max, and design min cfm.
- g. The hot water valve shall be modulated with a PI loop to maintain the discharge temperature at setpoint across the range of air flow.
- h. In cooling, the cfm setpoint shall be reset higher up to max cfm to satisfy the thermostat.
- i. When the zone is in deadband, the cfm setpoint shall be the minimum airflow setpoint and the reheat valve is closed.

- j. Heating is provided in 2 stages:
 - 1) From 0% - 50%, the heating loop shall reset the DAT up to the max DAT listing on the mechanical schedule.
 - 2) From 51% - 100%, the heating loop shall reset the cfm setpoint up to the max heating cfm setpoint on the mechanical schedule.
- k. When lighting control system or occupancy sensors determine that the zone is unpopulated for more than 15min, thermostat setpoints shall revert to relaxed values that are +/- 4°F (adj) from prior setpoint. If the AHU or overall building mode is in cooling, then 4°F added, if the AHU or overall building mode is in heating then 4°F subtracted. For VAV serving multiple spaces, occupancy must be off in all the associated zones.
- l. Open Window Setback per T24
 - 1) Refer to architectural plan for manually or automated operable windows.
 - 2) Per code, VAV serving multiple zones with multiple operable windows only need to have a window contact in the space with the thermostat. Note: there are instances where zones will have with multiple thermostats and this needs to be accounted for.
 - 3) Contact switches may be linked in series so that any open window triggers this sequence.
 - 4) Window status through software integration or hardwire contacts with an automated window control system is acceptable.
 - 5) When a window is proven open,
 - a) If the space is in cooling then the space setpoint must be relaxed to 90°F.
 - b) If the space is in heating then the space setpoint must be relaxed to 55°F.

4. Alarms

- a. If the measured cfm is not within 10% (adj) of setpoint, for more than 5 min (adj), generate an alarm.
- b. If the DAT is not within 2°F (adj) of setpoint, for more than 5 min, generate an alarm.
- c. Airflow sensor calibration: If the fan serving the zone has been off for 10 minutes and airflow sensor reading is above 20 CFM, generate an alarm.
- d. Leaking damper: If the damper position is 0% for 10 minutes and airflow sensor reading is above 50 CFM while the fan serving the zone is proven on, generate an alarm.
- e. Leaking valve: If the valve position is 0% for 15 minutes and discharge air temperature is above AHU SAT by 5°F, generate an alarm.

5. System Requests

- a. Air Pressure Requests
 - 1) If the damper position is greater than 85%, send 1 Request until the damper position is less than 75%,
 - 2) Else if the damper position is less than 75%, send 0 Requests
- b. HHW Pressure Requests
 - 1) If the HW valve position is greater than 85%, send 1 Request until the HW valve position is less than 75%
 - 2) Else if the HW valve position is less than 75%, send 0 Requests.

6. Trends

- a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
 - 1) Reheat valve position, DAT & DAT setpoint
 - 2) Damper position, CFM & CFM setpoint
 - 3) Tstat temp & setpoint
 - 4) Htg & Clg loop outputs

G. KEF

1. General

- a. Streivor OEM KEF provides constant speed ventilation air.
- b. Streivor KEF wall interface to be provided for users to control locally.
- c. BMS to integrate to Streivor controls for full monitoring and control.

2. KEF Control Logic

- a. This is a constant speed fan.
- b. The kitchen exhaust fan shall be enabled to run during occupied time schedule OR an occupant inputs an override command on the LCD wall control pad. Give precedence to the KEF LCD wall controls pad over the BMS enable through integration.
- c. The auto-start feature of the OEM controls shall set the KEF to run full speed when the temperature differential between ambient and hood temp exceeds user defined threshold.
- d. Upon detection of particles of combustion or as interlocks with the fire alarm system dictate, the KEF will full shut down. (Note: see fire alarm and ansul system design in respective dwgs or spec sections.)

3. Supply Fan Control

- a. Supply fan be provided with binary input to run when commanded by the hardwire interlock between the KEF and the supply fan.
- b. Supply fan always runs at constant speed.
- c. BMS to command the fan to run based on user supplied schedule OR whenever the KEF runs including any afterhours requests made from the KEF LCD wall panel. (Note: hardwire interlock not used for the purpose of turning on fan, use integration monitoring point instead.)
- d. The supply fan shall only be shut down by the hardwire interlock relay by the KEF OEM controller. This takes precedence in all instances because the KEF interlock kills fans when particles of combustion or when the fire alarm system dictate. (Note: see fire alarm and ansul system design in respective dwgs or spec sections.)

4. Alarms

- a. Annunciate all available alarms from the KEF OEM controls at the BMS front end.
- b. Annunciate any fire related shut downs from the KEF OEM controls at the BMS front end at the highest level of alarm.
- c. Generate a maintenance alarm when any of these fans have operated for more than 1500 hours or as recommended by the product manufacturer. Reset interval counter when alarm is acknowledged.
- d. When the Supply Fan filter pressure DP exceeds setpoint initially set at 1" (adj), send maintenance alarm at the front end.
- e. If supply or exhaust fan fails to reach commanded state for more than 5 min, send alarm.

5. Trends

- a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
 - 1) LCD wall panel overrides
 - 2) Fire Alarm shut down incidents
 - 3) Supply Fan speed & setpoint
 - 4) Kitchen Exhaust Fan speed & setpoint
 - 5) Ambient temp and hood temp

H. FCU – VRF INDOOR UNIT

1. General

- a. The VRF FCU provides cooling only.

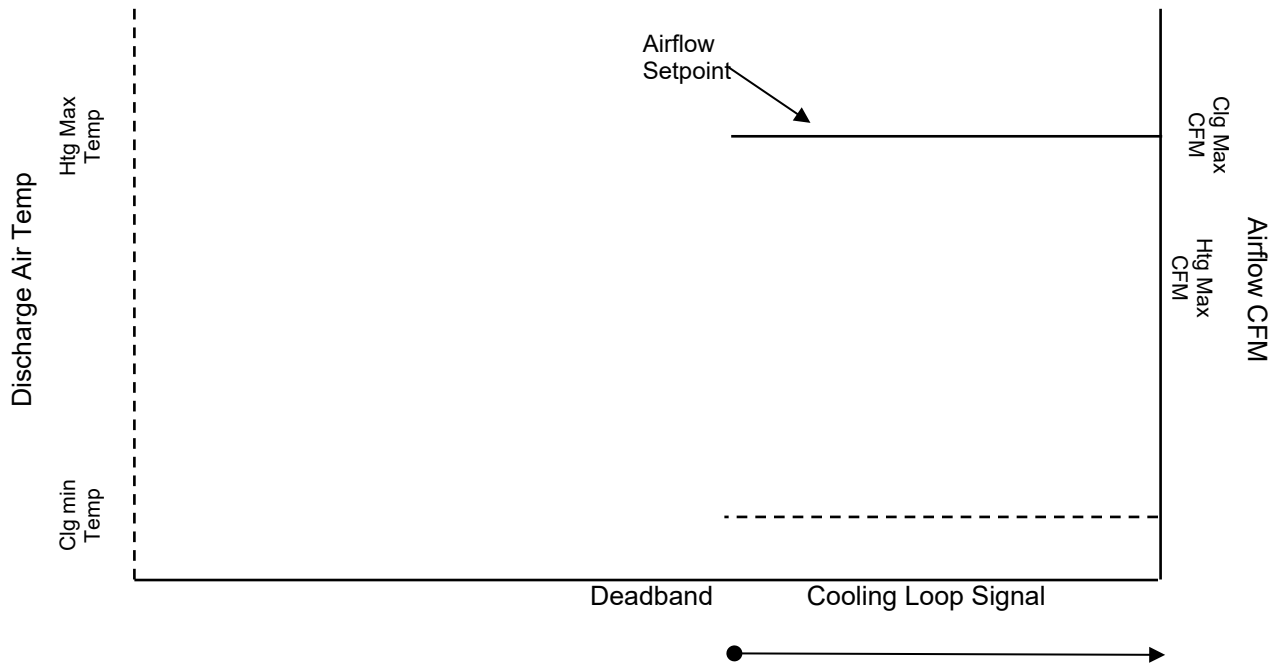
2. Modes

- a. 24/7/365 active

- b. Unoccupied mode: NA
- c. Morning warmup: NA
- 3. Supply fan and air temperature control Logic – Occupied Mode
 - a. Fan and coil controls is depicted schematically in the diagram below.
 - b.

VRF FCU CONTROL SCHEMATIC

Figure Below: There are 2 axes shown to depict the interaction of discharge air temp and fan speed. The dashed line corresponds the discharge air temp and the solid line corresponds to the fans speed. The zone thermostat sends binary heating or cooling command to a single speed fan to satisfy the zone.



- c. The zone thermostat sends binary cooling command to a single speed fan to satisfy the zone.
- 4. Display
 - a. Display shall have at a minimum:
 - 1) Zone temp present value
 - 2) Zone temp setpoint
- 5. Alarms
 - a. Annunciate all alarms available from FCU OEM controls at the front end.
 - b. If the room is not at setpoint for more than 10min (adj), send maintenance alarm at the front end.
- 6. Trends
 - a. The following trends should be made on 15min intervals, stored at the front end, and auto-exported to an admin user in .csv or .xml format:
 - b. Space thermostat temp & setpoint
- I. EF – Constant Speed
 - 1. These fans are constant speed units.

2. The BMS shall command them to run during occupied schedule.
3. Alarm at the front end when the EF status does not match the commanded state.
4. Use maintenance alarm when the fan runs for 1500 hrs.

J. AIR SOURCE HEAT PUMP - single skid – with 2p FCU

1. INTEGRATION AND STARTUP

- a. The compressors, fans and pumps shall run subject to internal controls only (no direct BMS control). BMS to send hardwire control input for HHW setpoint.
- b. Unit startup to be performed by mechanical contractor before integration to begin. Run all pumps and necessary downstream hydronics in hand if needed to all for proper startup of equipment.
- c. Upon sign-off of startup and verification of functionality, begin BMS integration. In this way potential commissioning issues can be sorted out without integration to blame.
- d. BMS integration via BACnet is to pull through all the monitoring points available from the ASHP. Display these on equipment graphic on the front end.

2. MODES

- a. Plant modes are based on a user provided building schedule.
- b. Plant is enabled during all modes except unoccupied mode.
- c. All control logic in this ASHP section is with regard to occupied mode unless specifically stated otherwise.

3. PLANT ENABLE/DISABLE

- a. Unit to operate in unoccupied mode until start of occupied mode.
- b. In occupied mode ASHP to sit idle in system standby until any of the following are true
 - 1) Any AHU valve goes open
 - 2) Then unit to start primary pumps, BMS to start secondary pumps and ASHP to begin producing HHW.

4. HOT WATER PRODUCTION

- a. The BMS shall command heat pump to produce chilled or hot water at the temperature on the mechanical drawings through integration.
- b. No automated temperature reset of the AHSP is required.
- c. Provide 30 min (adj) delay on make to prevent short cycling of run requests.

5. ASHP COMPRESSOR STAGING

- a. By internal unit controls, as required

6. PRIMARY PUMPS CONTROL

- a. Fixed speed by internal unit controls, as required.

7. SECONDARY HYDRONIC PUMPS

- a. Pumps are sized for 60% of design and shall be controlled on a lead/lag basis with lead pump determined by equal wear rotation logic. Pump staging is not necessary.
- b. Pumps shall be controlled to meet a fixed differential pressure setpoint. There may be more than one DP providing feedback to the pump controller. The design intent is to satisfy the hydronic branch/riser where the requests emanate from. Each branch/riser will have an associated range of setpoints based on the diversity of active valves applied at time of water balance.
- c. Coordinate with TAB contractor to determine what the appropriate DP sensor reading should be at 33%, 66% and 100% system flow.
- d. (Note: refer to trim and respond logic in the general section of the spec for reference info for trim and respond).

8. PLANT STARTUP SQUENCE

- a. To make the ASHP operational from off or idle the BMS should execute the following steps safely bring the equipment online.
 - 1) Start the lead secondary pump at min speed corresponding to the min flow bypass circuit setters.

- 2) Command the ASHP to start primary pump
- 3) Command the ASHP to produce HHW at the desired temp.

9. ALARMS

- a. BMS to annunciate all alarms available from OEM controller at the front end.
- b. Maintenance interval alarm when fan has operated for more than 1,500 hours. Reset interval counter when alarm is acknowledged.
- c. If ASHP shuts down when not commanded to shut down, send highest level of alarm at the front end and email admin user.

10. TRENDS

- a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
 - 1) Outside air temp
 - 2) Primary HHW supply and return temp
 - 3) Secondary HHW supply and return temp
 - 4) Secondary flow gpm
 - 5) ASHP HHW supply temp setpoint
 - 6) HHW secondary pump speed
 - 7) HHW DP & DP setpoint
 - 8) Btu of heat produced
 - 9) ASHP kW & kWh

3.03 CEILING FANS

1. General

- a. Ceiling fan will be on manual control apart from the BMS.
- b. Refer to dwgs for appropriate window switch placement.
- c. Note: see Fire Alarm design for requirements associated with shut down in the event of fire.

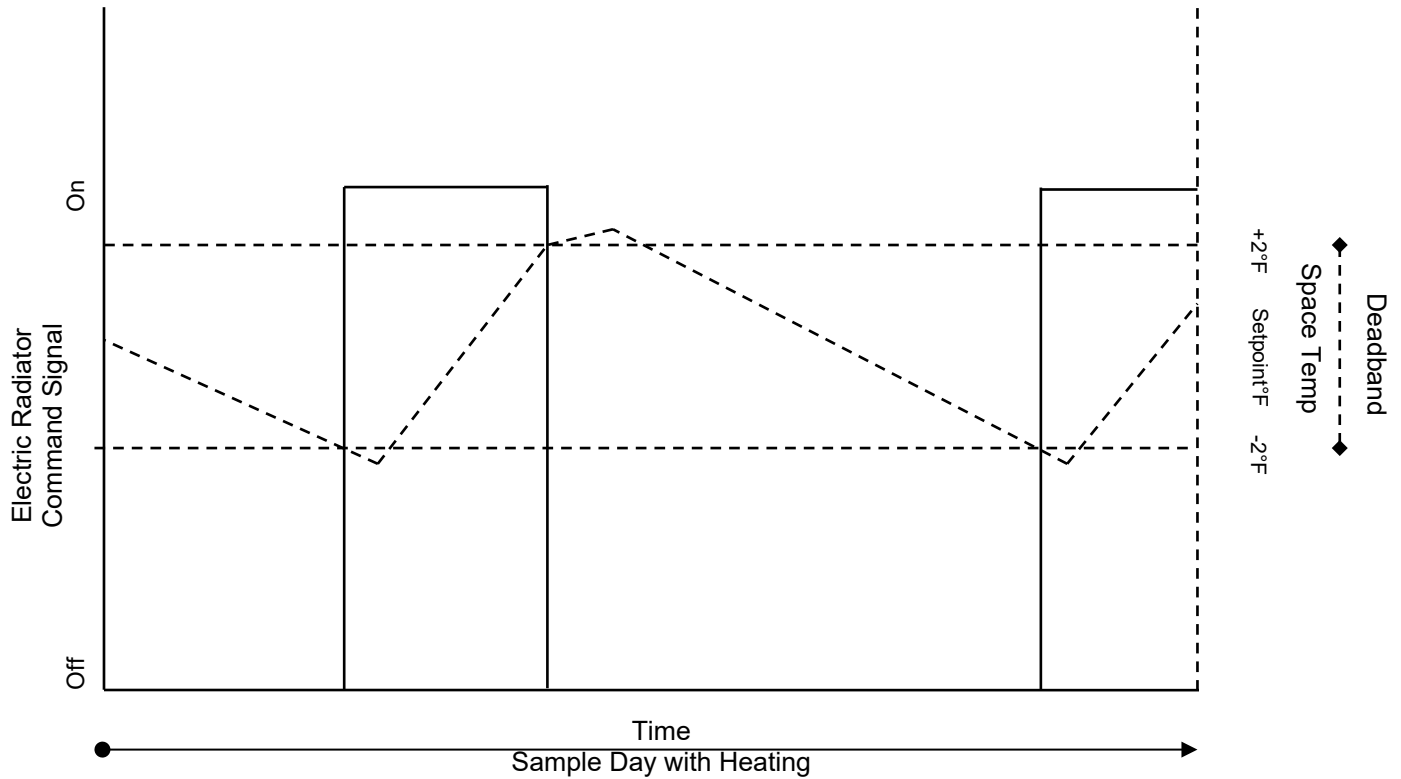
3.04 RADIATORS

A. Electric Radiator – Lounges & Common Areas

1. General

- a. Electric radiators will be on OEM control apart from the BMS.
- b. Refer to controls diagram for the introduction of a manual wall timer to the radiator thermostat.

- c. Electric radiator is controlled with deadband control as schematically shown in the diagram below.



- d.
e. Figure above: There are two y-axis whose line dash style corresponds to the associated line. The dashed line is for space temperature as measured by the thermostat. The solid line is for the electric radiator response.

f. Heating control:

- 1) The electric radiators in the room shall be controlled in unison with the same output signal.
- 2) thermostat uses deadband control to maintain space temperature.
- 3) Disable the electric radiators when any window or exterior door in the zone is open or when occupancy sensor indicates zone is unpopulated. (Link window contact(s), exterior door(s) and occupancy sensor(s) in series to the same input on the thermostat.)

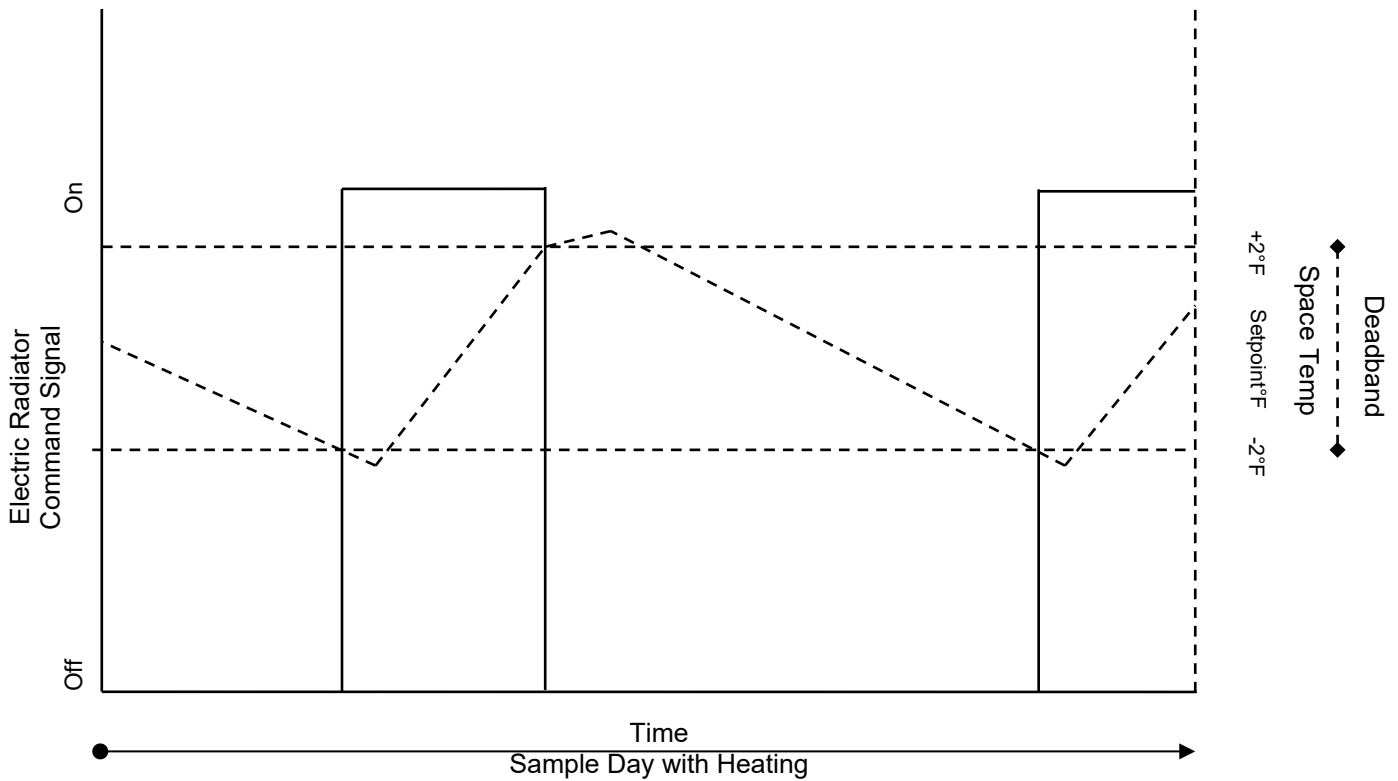
B. Electric Radiator – Residential Dorms

1. General

- a. The electric radiators will provide heat to the zone.
- b. Cooling for this zone is not provided.
- c. Control is provided with a 120V, 7 day programmable thermostat.
- d. Unit is disabled based on status of window or exterior door contact switch.
- e. This device is not controlled or monitored by the BMS system in any way.

2. Temperature Control

- a. Electric radiator is controlled with deadband control as schematically shown in the diagram below.
- b.



- c. Figure above: There are two y-axis whose line dash style corresponds to the associated line. The dashed line is for space temperature as measured by the thermostat. The solid line is for the electric radiator response.
- d. Heating control:
 - 1) thermostat uses deadband control to maintain space temperature.
 - 2) Disable the electric radiators when any window or exterior door in the zone is open. (Link window contact(s) and exterior door(s) in series to the same input on the thermostat.)

3.05 METERING

A. Resource Meters

- 1. Connect BAS to outputs for each meter shown on Contract Drawing control schematics.
 - a. For pulse output meters, determine and verify conversion between pulse count and resource consumption. Document the value and source of the conversion factor as a comment in notes section of meter graphic.
 - b. For meters using analog outputs, determine and verify conversion between analog signal and rate of resource consumption. Document the value and source of the conversion factor in notes section of meter graphic.
 - c. For networked meters, map meter points to BAS using BACnet point auto-discovery.
- 2. All resource meters shall be trended at 15 min intervals.
- 3. All meter trends must be archived at the front end.

- a. DDC contractor responsible for establishing controller archiving intervals that will prevent the local controller memory from running out.
 - b. Suggested trend archival interval set to midnight every day, however a shorter interval may be necessary if multiple meters are networked.
4. Auto-Export meter data as a .csv file in an email attachment to the email address of admin user.
5. Meter graphics:
- a. Every meter type (water, electric, thermal) must have its own tab at the front end.
 - b. This resource tab must have a summary table with rows that show all meters.
 - c. Electricity meters must display the following points for each meter:
 - 1) Consumption (kWh) present value
 - 2) Demand (kW) present value
 - 3) Voltage for each phase, and 3-phase average, present value
 - 4) Current for each phase and 3-phase average, present value
 - 5) Power Factor (%) for each phase and 3-phase average, present value
 - d. Water Meters must display the following points for each meter:
 - 1) Consumption, display cumulative gallons since first day of billing cycle.
Default value of 1st of month
 - 2) Flow (GPM) present value
 - e. Thermal Energy
 - 1) Btu produced, present value

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Copper building wire rated 600 V or less.
 2. Metal-clad cable, Type MC, rated 600 V or less.
 3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

1.03 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable-frequency controller.

1.04 ACTION SUBMITTALS

- A. Sustainable Design Submittals:
 1. Product Data: For each conductor and cable indicating lead content.
 2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 3. : For solvents and adhesives, indicating VOC content.
 4. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire Company.
 - 2. American Bare Conductor.
 - 3. Belden Inc.
 - 4. Cerro Wire LLC.
 - 5. Encore Wire Corporation.
 - 6. General Cable Technologies Corporation.
 - 7. Okonite Company (The).
 - 8. Service Wire Co.
 - 9. Southwire Company.
 - 10. WESCO.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 3. Type XHHW-2: Comply with UL 44.

2.02 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire Company.
 - 2. American Bare Conductor.
 - 3. Belden Inc.
 - 4. General Cable Technologies Corporation.
 - 5. Okonite Company (The).
 - 6. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit and multicircuit with color-coded conductors.
- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Bare or Insulated.

- G. Conductor Insulation:
 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.
 3. .

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.03 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. 3M Electrical Products.
 2. AFC Cable Systems; a part of Atkore International.
 3. Gardner Bender.
 4. Hubbell Power Systems, Inc.
 5. ILSCO.
 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
 7. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 1. Material: Copper.
 2. Type: Two hole with long barrels.
 3. Termination: Crimp.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway .
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
 1. Underground distribution grounding.
 2. Foundation steel electrodes.

1.03 ACTION SUBMITTALS

- A. Sustainable Design Submittals:
 1. Product Data: For each conductor and cable indicating lead content.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 1. Test wells.
 2. Ground rods.
 3. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.
 - 3) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at test wells grounding connections for separately derived systems based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.

- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. ILSCO.
 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 5. SIEMENS Industry, Inc.; Energy Management Division.
 6. Thomas & Betts Corporation; A Member of the ABB Group.

2.03 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.
- D. Lead Content: Less than 300 parts per million.

2.04 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

- K. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.
- N. Lead Content: Less than 300 parts per million.
- O.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.05 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- G. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.06 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least two -rod lengths from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- I. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Steel slotted support systems.
 2. Aluminum slotted support systems.
 3. Conduit and cable support devices.
 4. Support for conductors in vertical conduit.
 5. Structural steel for fabricated supports and restraints.
 6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 7. Fabricated metal equipment support assemblies.
- B. Related Requirements:
 1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Unistrut; Part of Atkore International.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) B-line, an Eaton business.
 - 2) Hilti, Inc.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 102.
 - 4. NECA 105.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Metal conduits and fittings.
 2. Nonmetallic conduits and fittings.
 3. Metal wireways and auxiliary gutters.
 4. Surface raceways.
 5. Boxes, enclosures, and cabinets.
 6. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
 2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
 3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
 4. Section 270533 "Conduit Boxes Communications" for multiservice floorbox and poke-thru types.
 5. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches (300 mm) long.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 1. Structural members in paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 3. Where raceways are crossing exposed ceiling spaces visible to the building occupants.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Calconduit.
 - d. Electri-Flex Company.
 - e. FSR Inc.
 - f. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - g. Patriot Aluminum Products, LLC.
 - h. Thomas & Betts Corporation; A Member of the ABB Group.
 - i. Western Tube and Conduit Corporation.
 - j. Wheatland Tube Company.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch (1 mm), minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. FSR Inc.
 - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - f. Thomas & Betts Corporation; A Member of the ABB Group.
 - g. Western Tube and Conduit Corporation.
 - h. Wheatland Tube Company.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Arco Corporation.
 - c. CANTEX INC.
 - d. Electri-Flex Company.
 - e. RACO; Hubbell.
 - f. Thomas & Betts Corporation; A Member of the ABB Group.
- 2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 3. ENT: Comply with NEMA TC 13 and UL 1653.
- 4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- 5. LFNC: Comply with UL 1660.
- 6. Rigid HDPE: Comply with UL 651A.
- 7. Continuous HDPE: Comply with UL 651A.
- 8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- 9. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Arco Corporation.
 - c. CANTEX INC.
 - d. FRE Composites.
 - e. RACO; Hubbell.
 - f. Thomas & Betts Corporation; A Member of the ABB Group.
- 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
- 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. B-line, an Eaton business.
- 2. Hoffman; a brand of Pentair Equipment Protection.
- 3. MonoSystems, Inc.
- 4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.

- 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. MonoSystems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- C. Surface Aluminum Raceways: Alloy 6063-T5 extruded aluminum, minimum thickness 0.050 inches. Satin, No. 204 clear anodized, 0.004 inch thick, Class R1 Mil-Spec finish. Device cover plates suitable to mount commercially available duplex devices, single 1.40 inch and 1.59 inch diameter receptacles, GFCI, surge receptacles and other rectangular faced devices, and voice and data jacks. Devices shall be mounted to cover plates held in place by extruded protrusions. Cover plates shall be removable using standard screwdriver without marring the finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Adalet.
 - 2. Crouse-Hinds, an Eaton business.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a brand of Pentair Equipment Protection.
 - 7. Hubbell Incorporated.
 - 8. Hubbell Incorporated; Wiring Device-Kellems.
 - 9. Kraloy.
 - 10. MonoSystems, Inc.
 - 11. Oldcastle Enclosure Solutions.
 - 12. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 13. RACO; Hubbell.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Thomas & Betts Corporation; A Member of the ABB Group.
 - 16. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

- C. Sheet Metal pressed Outlet and Device Boxes with not welded edges: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 - 1. Type FB01, Multi-service flush mounted floor box with UL scrub water approved.
 - a. Material: Cast metal.
 - b. Type: Fully adjustable.
 - c. Shape: Rectangular.
 - d. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Type FB20, Recessed multi-service flush mounted box with hinged cover and cord access flap with UL scrub water approved label..
 - a. Material: Cast metal.
 - b. Type: Fully adjustable.
 - c. Shape: Rectangular.
 - d. Size: 10"x12"x6" Deep
 - e. Knock –out fittings: (8) ¾", (12) concentric 1"/1¼"/1½"
 - f. Cover:: Cover with brass carpet flange, life off door and UL scrube water rated for tile and carpet installation, coordinate brass flange height with architect Solid cover with cable exit, no trim, color as selected by Architect
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- L. Gangable boxes are prohibited.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. NewBasis.
 - c. Oldcastle Enclosure Solutions.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
 2. Standard: Comply with SCTE 77.
 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, "ELECTRIC."
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.07 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC IMC EMT.
 3. Underground Branch Conduit: RNC, Type EPC-40-PVC, concrete encased.
 4. Underground Feeder Conduit: Type EPC-40-PVC concrete encased.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

- a. Loading dock.
- b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
- c. Mechanical rooms.
- d. Gymnasiums.
- 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
- 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
- 6. Damp or Wet Locations: IMC.
- 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Interior Raceway Size: 3/4-inch (21-mm) trade size.
- D. Minimum Exterior Raceway Size: 1-1/4"inch (32-mm) trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- G. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- H. Install surface raceways only where indicated on Drawings.
- I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 RACEWAY SEPARATION OF SYSTEM WIRING

- A. Provide minimum separations between power and wiring and signal system wiring as indicated in table below. Where minimum separation can not be maintained due to existing conditions obtain written permission for closer spacing.

B.	C. Power Raceways (70 Volts or More)	D. Transformers, Motors and Motor Starters	E. Power Raceways with Dimming Circuits	F.	L
G. Telephone	H. 5"	I. 12"	J. 24"	K.	1.
L. DATA	M. 5"	N. 12"	O. 24"	P.	1.
Q. Paging Sound /	R. 5"	S. 12"	T. 24"	U.	5"
V. Security	W. 5"	X. 12"	Y. 24"	Z.	5"
AA. CCTV	BB. 5"	CC. 12"	DD. 24"	EE.	5"
FF. Monitoring and Control	GG. 5"	HH. 12"	II. 24"	JJ.	5"

B.		C. Power Raceways (70 Volts or More)	D. Transformers, Motors and Motor Starters	E. Power Raceways with Dimming Circuits	F. L F
KK. Fire Alarm	LL. 5"		MM. 12"	NN. 24"	OO. 5"
PP. Cable Tray	QQ. 12"		RR. 24"	SS. 24"	TT. 1"

3.03 RACEWAY APPLICATIONS

ENVIRONMENT	RACEWAYS	BOXES, ENCLOSURES, AND CABINETS
Dry locations, concealed	RMC, IMC, EMT, FMC, LFMC, WW	SM, FS/FD; NEMA 1
Dry locations, exposed, subject to damage*	RMC, IMC	SM, FS/FD; NEMA 1
Dry locations, exposed, not subject to damage*	RMC, IMC, EMT, FMC, LFMC, WW	SM, FS/FD; NEMA 1
Wet locations, subject to damage ^{9*}	RMC ³ , IMC ³	FS/FD; NEMA 4, 4X
Wet locations, not subject to damage ⁹	RMC ³ , IMC ³ , EMT ³ , LFMC, WW ⁷	FS/FD; NEMA 4, 4X
Outdoor locations, exposed to rain, sleet, windblown dust, and external icing	RMC ³ , IMC ³ , WW ⁷ , LFMC ¹²	FS/FD; NEMA 3, 3R, 3S
Outdoor locations, underground ⁹	RMC, IMC, PVC, LFMC	SCTE 77
Outdoor locations, submerged ⁹	RMC ³ , IMC ³ , PVC	NEMA 6, 6P
Outdoor locations, embedded in concrete ⁹	RMC, IMC, EMT ⁴ , PVC	FS/FD
Under concrete slab ⁹	RMC, IMC, PVC	N/A
Underground, direct burial ⁹	RMC ³ , IMC ³ , PVC, LFMC	SCTE 77
Embedded burial ⁹	RMC, IMC, PVC	N/A
Industrial location, general	RMC, IMC, EMT, FMC, LFMC, WW	FS/FD, SM; NEMA 12, 12K
Industrial location, subject to corrosion ⁹	RMC ³ , IMC ³ , LFMC	NEMA 4X, 11
Industrial location, subject to	RMC, IMC, LFMC	FS/FD; NEMA 13

ENVIRONMENT	RACEWAYS	BOXES, ENCLOSURES, AND CABINETS
oil and vapors		
Hazardous Class I, Division 1	RMC, IMC	NEMA 7, 8
Hazardous Class I, Division 2⁸	RMC, IMC, LFMC, FMC ¹¹ , WW ⁵	FS/FD; NEMA 1, 7, 8, 12
Hazardous Class II, Division 1	RMC, IMC, LFMC	NEMA 9
Hazardous Class II, Division 2⁸	RMC, IMC, LFMC, WW ⁶	FS/FD; NEMA 1, 9, 12
Hazardous Class III⁸	RMC, IMC, LFMC, WW ⁶	FS/FD; NEMA 12
<p>Legend: EMT Electrical metallic tubing ENT Electrical nonmetallic tubing FMC Flexible metal conduit FS/FD Cast-metal box HDPE High-density polyethylene conduit IMC Intermediate metal conduit LFMC Liquidtight flexible metal conduit LFNC Liquidtight flexible nonmetallic conduit N/A Not applicable NEMA Refers to NEMA 250, type classification NM Nonmetallic box PVC Rigid polyvinyl chloride conduit RMC Rigid metal conduit RTRC Reinforced thermosetting resin conduit SM Sheet-metal box WW Wireway</p>	<p>Notes: 1. Building finishes must provide a barrier with a 15-minute fire rating. 2. For buildings not more than three stories above grade. 3. Corrosion protection is required. 4. With fittings for purpose. 5. Enclosed and gasketed. 6. Dust-tight wireway only. 7. Raintight wireway only. 8. Nonincendive and intrinsically safe wiring are allowed in any wiring method permitted for unclassified locations. 9. Aluminum materials are permitted only with approved supplementary corrosion protection. 10. Schedule 80. 11. Only as specifically permitted under the environmental condition. 12. Subject to temperature limitations where exposed to sunlight. * "Subject to damage" denotes environments where exposed raceways may be impacted by traffic, by cleaning or maintenance operations, or by similar influences.</p>	

3.04 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.

- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install, for 70 volt and above, no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Install, for below 70 volt raceways, no more than the equivalent of two 90-degree bends in any conduit run. Support within 12 inches (300 mm) of changes in direction.
- J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- K. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- L. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- M. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from RNC, Type EPC-40-PVC, to GRC before rising above floor.
- N. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

- V. Surface Raceways:
 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.

- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

- Z. Expansion-Joint Fittings:
 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - b. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - c. Attics: 135 deg F (75 deg C) temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.

- BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.05 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Branch Circuit Conduit (600 V and below):
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
 2. Install backfill as specified in Section 312000 "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
 4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.06 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.07 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.08 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.09 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 0544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content
 - 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Wall Sleeves:
 - 1. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Holdrite (Engineered Sleeve Solutions).

- c. Pipeline Seal and Insulator, Inc.
- 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- 3. Pressure Plates: Carbon steel.
- 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.

2.04 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have a VOC content of 50 g/L or less.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 0548
SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Restraint channel bracings.
 2. Restraint cables.
 3. Seismic-restraint accessories.
 4. Mechanical anchor bolts.
 5. Adhesive anchor bolts.
- B. Related Requirements:
 1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:
 1. Control and monitoring panels.
 2. Generators.
 3. Luminaires.
 4. Panelboards.
 5. Photovoltaic system components.
 6. Substations.
 7. Switchboards.
 8. Transformers.
- B. Qualification Data: For testing agency.
- C. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.

- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Building Classification Category: III.
 - 2. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the CBC: B.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the CBC: III.
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 1.5.
 - c. Component Amplification Factor: 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Refer to drawing S/S-001
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: Refer to drawing S/S-001

2.02 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut; Part of Atkore International.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.03 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Vibration & Seismic Technologies, LLC.
 - 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.04 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.05 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. B-line, an Eaton business.
 2. Hilti, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

- 5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 2. Labels.
 3. Bands and tubes.
 4. Tapes and stencils.
 5. Tags.
 6. Signs.
 7. Cable ties.
 8. Paint for identification.
 9. Fasteners for labels and signs.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 1. Color shall be factory applied.
 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.

- b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White or gray.
 - 5. Color for Equipment Grounds: Green.
 - 6. Colors for Isolated Grounds: Green with white stripe.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
- 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
- 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
- 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
- F. Equipment Identification Labels:
- 1. Black letters on a white field.

2.03 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Panduit Corp.
 - c. Seton Identification Products.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Panduit Corp.
 - c. Seton Identification Products.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Ideal Industries, Inc.
 - d. Panduit Corp.
 - e. Seton Identification Products.
 - 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Ideal Industries, Inc.
 - d. Marking Services, Inc.
 - e. Panduit Corp.
 - f. Seton Identification Products.
 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

2.05 TAPES AND STENCILS

- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services, Inc.
- B. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. LEM Products Inc.
 - b. Marking Services, Inc.
 - c. Seton Identification Products.

- C. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. Seton Identification Products.

- D. Underground-Line Warning Tape:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.
 - 2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - 4. Tag: :
 - a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches (75 mm).
 - c. Overall Thickness: 8 mils (0.2 mm).
 - d. Foil Core Thickness: 0.35 mil (0.00889 mm).
 - e. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
 - f. Tensile according to ASTM D 882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.06 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.

- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch (0.58 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.
- C. Write-on Tags:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. Seton Identification Products.
 2. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
 3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.07 SIGNS

- A. Baked-Enamel Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. Marking Services, Inc.
 2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 3. 1/4-inch (6.4-mm) grommets in corners for mounting.
 4. Nominal Size: 7 by 10 inches (180 by 250 mm).
- B. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services, Inc.
 2. Engraved legend.
 3. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Ideal Industries, Inc.
 2. Marking Services, Inc.
 3. Panduit Corp.
- B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.

- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.
- X. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.

- Y. Write-on Tags:
 1. Place in a location with high visibility and accessibility.
 2. Secure using plenum-rated cable ties.
- Z. Baked-Enamel Signs:
 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- AA. Laminated Acrylic or Melamine Plastic Signs:
 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- BB. Cable Ties: General purpose, for attaching tags, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.
 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot (3-m) maximum intervals.
- D. Accessible Raceways and Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- E. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."
 4. "FIRE ALARM"
- F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use snap-around color-coding bands to identify the phase.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

- G. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- J. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- K. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- L. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- M. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- N. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- Q. Arc Flash Warning Labeling: Self-adhesive labels.
- R. Main Electrical Room: Framed with glass protective cover a full size drawing of project electrical single line diagram including all Project Record changes wall. Where multiple drawings are included in construction documents provide one for each sheet.
- S. Operating Instruction Signs: Self-adhesive labels.
- T. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- U. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Stenciled legend 4 inches (100 mm) high.

3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power-transfer equipment.
 - p. Contactors.
 - q. Remote-controlled switches, dimmer modules, and control devices.
 - r. Battery-inverter units.
 - s. Battery racks.
 - t. Power-generating units.
 - u. Monitoring and control equipment.
 - v. UPS equipment.

END OF SECTION

SECTION 26 0572
OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.03 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Short-circuit study input data, including completed computer program input data sheets.
 - 2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
 - b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Short-Circuit Study Specialist.
- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.06 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

- B. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
- C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
 - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

- a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
- a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
- a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.
 1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance at the service.
 3. Power sources and ties.
 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.

7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.02 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- F. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
 1. Electric utility's supply termination point.
 2. Incoming switchgear.
 3. Unit substation primary and secondary terminals.
 4. Low-voltage switchgear.
 5. Motor-control centers.
 6. Control panels.
 7. Standby generators and automatic transfer switches.
 8. Branch circuit panelboards.
 9. Disconnect switches.

3.03 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.04 DEMONSTRATION

- A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 26 0573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.03 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and equipment evaluation reports.
 - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Coordination Study Specialist Field Adjusting Agency.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. The following parts from the Protective Device Coordination Study Report:
 - 1) One-line diagram.
 - 2) Protective device coordination study.
 - 3) Time-current coordination curves.
 - b. Power system data.

1.07 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

2.02 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study:
 - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 - 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.

- h. Motor-starting characteristics and motor damage points.
- i. Generator short-circuit decrement curve and generator damage point.
- j. The largest feeder circuit breaker in each motor-control center and panelboard.
- 5. Series rating on equipment is not allowed.
- 6. Provide adequate time margins between device characteristics such that selective operation is achieved.
- 7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- F. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- G. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
 - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- I. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.
- J. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
 - 1. Electric utility's supply termination point.
 - 2. Switchgear.
 - 3. Unit substation primary and secondary terminals.
 - 4. Low-voltage switchgear.
 - 5. Standby generators and automatic transfer switches.
 - 6. Branch circuit panelboards.
- L. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Any application of series-rated devices shall be allowed.

3.03 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the overcurrent protective device study.
 - 1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus, three phase and line-to-ground.
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.04 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.05 DEMONSTRATION

- A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION

SECTION 26 0574
OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.03 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Arc-Flash Study Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.07 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 1. Protective device designations and ampere ratings.
 2. Cable size and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."
- F. Arc-Flash Study Output:
 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.

- d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- G. Incident Energy and Flash Protection Boundary Calculations:
- 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Working distance.
 - 6. Incident energy.
 - 7. Hazard risk category.
 - 8. Recommendations for arc-flash energy reduction.
- H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.03 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Flash protection boundary.
 - 4. Hazard risk category.
 - 5. Incident energy.
 - 6. Working distance.
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.02 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:
 - 1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.03 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.
 - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus, three phase and line-to-ground.
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
 - 8. For reactors, provide manufacturer and model designation, voltage rating and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.04 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Control panel.

3.05 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.06 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 26 0800
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 1. Section includes requirements for furnishing all labor, materials, and technical supervision to perform training for equipment and special systems described herein.
 2. Electrical Systems Commissioning consists of static checks of component and system installations and actual testing of equipment conditions and functions.
 3. Section specifies that Contractor shall engage the services of a recognized independent testing company for performing final inspections and tests as specified.
 4. The testing company shall provide all material, test instruments, equipment, labor, and technical supervision to perform such tests and inspections.
 5. It is the intent of these tests to verify that electrical equipment is operational within industry and manufacturer's tolerances, and is installed in accordance with these specifications.
 6. Perform tests, calibration, adjustment of relays and inspections before energizing any equipment.
 7. Upon completion of the tests and inspections specified, a label shall be provided in accordance with NETA labeling.
 8. Relay settings shall be made using approved relay setting reports, arc-flash, short circuit and coordination studies.
 9. Commissioning Authority will review and approve, prior to use, all test procedures and forms used and will witness a varying fraction of the initial checks and testing performed by the Subcontractor. The Commissioning Authority will review the completed check and test documentation of the Subcontractor of all checks and tests.
 10. The test requirements listed in this section do not release the Subcontractor from the obligation to perform all other appropriate, industry standard, manufacturer-recommended or code-required checks and tests.
- B. Related Requirements:
 1. Division 260553 Section "Overcurrent Protective Device Short Circuit Study" for Minimum fault current levels at equipment.
 2. Division 260573 Section "Overcurrent Protective Device Coordination Study" for Device coordination settings.
 3. Division 260574 Section "Overcurrent Protective Device Arc-Flash Study" for PPE signage and requirement labeling.
 4. Division 26 Section "Lighting Controls" for lighting control sequence of operation requirements.
 5. Division 262713.05 Section "Electricity Metering – M&V".
 6. Division 263213 Section "Diesel Engine Generators"
 7. Division 263353 Section "Static Uninterruptable Power Supply"

1.03 DEFINITIONS

- A. Commissioning Authority (CA)
- B. Certified Testing Agency (CTA)

1.04 QUALITY ASSURANCE

- A. Referenced Standards:
 1. OSHA Part 1910; Subpart S. 1910.308.
 2. American National Standards Institute: ANSI
 3. American Society for Testing and Materials: ASTM
 4. Association of Edison Illuminating Companies: AEIC
 5. Institute of Electrical and Electronics Engineers: IEEE
 6. Insulated Cable Engineers Association: ICEA
 7. National Electrical Manufacturers Association: NEMA
 8. National Electrical Testing Association: NETA
 9. National Fire Protection Association (NFPA)

- B. All inspections and tests shall use the following references.
 1. Contract Specifications.
 2. Drawings.
 3. Manufacturer's instruction manuals and approved shop drawings for applicable equipment.
 4. "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" by International Electrical Testing Association (NETA).

- C. Certified Testing Agency Qualifications: Member Company of NETA or an NRTL.

1.05 COMMON RESPONSIBILITY

- A. The following are responsibilities applicable to all electrical systems being commissioned.

- B. The general commissioning requirements and coordination in Division 01 apply to electrical systems. The Subcontractor shall be familiar with all parts of Division 01 commissioning requirements and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

- C. The work of this section shall be performed by a Certified Testing Agency, Electrical. The Commissioning Authority has some testing responsibilities for some equipment. The specified checks and static tests are conducted by any of the above listed parties, but the tests requiring measurements or special tools or skills are generally conducted only by the CTA. The Check and Testing Responsibility Table, included as a supplement to Division 01 Section "General Commissioning Requirements" provides specific allocation of checklist oversight and testing responsibilities. The Certified Testing Agency, Electrical Contractor, and Manufacturers Service Representative shall document all checks and testing on check and test procedure forms submitted to and approved by the Commissioning Authority prior to testing.

- D. Certified Testing Agency shall notify the Construction Manager when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

- E. The Commissioning Authority shall notify the Construction Manager ahead of time when commissioning activities not yet performed or not yet scheduled will delay construction. The Commissioning Authority shall be proactive in seeing that commissioning processes are executed and that the Contractor has the scheduling information needed to efficiently execute the commissioning process.

- F. Certified Testing Agency shall notify the Construction Manager a minimum of two weeks before commencement of testing.

- G. Certified Testing Agency shall be responsible for implementing final settings and adjustments on protective devices with contractors assistance.

- H. The Contractor shall respond to notices of issues identified during the commissioning process, making require corrections or clarifications and returning prompt notification to the Commissioning Authority.

- I. When completion of a task or other issue has been identified as holding up any commissioning process, particularly functional testing, the contractor shall, within two (2) days of notification of the issue, notify the Commissioning Authority in writing providing an expected date of completion. The contractor shall notify the Commissioning Authority in writing within one day of completion. It is not the responsibility of the Commissioning Authority to obtain this status information through meeting attendance, asking questions or field observation
- J. Construction Checklists. The Commissioning Authority Contractor shall develop checklists. At a minimum, for a given piece of equipment, checks from the inspection checklists in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems shall be included in the electrical checklists. The contractor shall execute and document all checks.
- K. Check and testing procedure and startup plan development and execution responsibilities are described in the Check and Testing Responsibility Table.
- L. The contractor shall review design documents, shop drawings and Operation and Maintenance manuals and manufacturer recommended installation and testing procedures of each system installation.
- M. The contractor shall monitor installation to ensure the equipment, configuration and quality of construction meets the design requirements, approved submittals and shop drawings.
- N. Certified Testing Agency shall maintain a written record of tests and upon completion of the work, assemble and certify a final test report. A final test report shall be submitted to the Construction Manager for review and comment before the final report is submitted.

1.06 CHECK AND TESTING RESPONSIBILITY TABLE.

- A. Column heading Key
 - 1. Submittal Review: Review submittals of commissioned equipment for either information to assist in test writing and field verification (designated by an (i) in the table), or for a more thorough review to make comments parallel with the A/E reviews (r).
 - 2. Field Observation: General observation of installation to become familiar with equipment and secondarily to identify problems.
 - 3. Perform and Document Checklists: The first indicated party is responsible to execute the check-lists and document each line item. The Commissioning Authority spot-witnesses check listing and startup and reviews the completed versions (reports). Any Construction Checklists or Startup Plans developed by the Commissioning Authority are reviewed by the Trade Subcontractors and visa-versa prior to execution.
 - 4. Prepare Test Procedures: Develop the written step-by-step test procedures and documentation forms for mechanical systems. For electrical component tests these procedures may be more checklist in nature and not include all specific procedural details, though all measurements will be recorded.
 - 5. Oversee and Document Tests.
 - a. Ensure that tests are scheduled and coordinated with the interfaces to other systems and requirements of the authorities having jurisdiction.
 - b. Develop a logical test plan that flows from the component level on the various systems to the integrated testing of the systems as they interact with each other.
 - c. Direct the order that test procedures are conducted. Coordinate and manage the parties participating in the testing.
 - d. Verify that all necessary documentation requirements are met for all parties including but not limited to authorities having jurisdiction, the Owner, the Commissioning Authority.
 - e. Facilitate effective communication and coordination across trades and disciplines as required for successful integrated testing of systems and assemblies.
 - f. Witness entire test and fully document on approved forms the methods, procedures and results of each test procedure of all tests.

6. Perform Test: Manipulate equipment or systems or set up and initiate actions on assemblies that demonstrates function and performance.
 7. Witness: (See also applicable footnotes.)
 - a. Spot: (s) in the table. Spot witnessing of testing shall include a large enough sample to provide reasonable confidence that the tests were conducted properly. Sampling may be random or focused as determined by the Commissioning Authority. For selected systems such as Overcurrent devices coordination and arc-flash labeling, spot witnessing may only require reviewing means and methods at the beginning of the test and a review of the test report.
 - b. All: (a) in the table. Witness the duration of all test procedures performed. Note that for some systems where there is a sampling strategy, not all systems will be tested, but all that are tested, will be witnessed. Refer to the testing requirements in the referenced Sections for details.
 - c. Witnessing does not necessarily include documenting of individual test or observation results, but does include recording attendance and general results.
 8. Prepare Test Report: Assembly and review the testing documentation. Report information could be gathered and incorporated into final report by Commission Agent or in some cases documented by commissioning agent.
- B. The contractor shall develop test procedures and forms and execute and document testing according to the requirements of this Section, Division 01, and other specification sections containing testing requirements.
- C. Tests of energized equipment shall be conducted when the equipment is operating at its normal capacity. This may require some tests to be conducted after occupancy.
- D. Training and Orientation. The Subcontractor shall follow the facility staff orientation and training requirements as described in Division 01 Section "Demonstration and Training" and other applicable technical sections.
- E. Operation And Maintenance (O&M) Manuals. Refer to Division 01 Section "General Commissioning Requirements" and Division 01 Section "General Requirements" for requirements for O&M manuals. Contractor shall perform routine insulation resistance, continuity and rotation tests for distribution and utilization equipment before tests performed by the testing company specified.

System	Components	Submittal Review	Field Observation	Perform and Document Check Lists	Prepare Test Procedures	Oversee and Documentation	Perform Test	Witness	Prepare Test Reports
Electrical									
Medium Voltage Cables	All	i/CA, r/AE	CA	CA	CA	CA	CTA	a/CA	CTA
Grounding	Main Electrical Room and Ground Rods	i/CA, r/AE	CA	CA	CA	CA	CTA	s/CA	CTA
Fault Current Ratings	All Switch gear	i/CA, r/AE	CA, EC	EC	EC	CA		s/CA	EC, CTA

Protective Device Settings	All Protective Devices > 250 Amp	AE	CA, AE	CA	CA, MSR	CA, MSR	CTA	s/CA, a/MSR	CTA
Arc-Flash	All Electrical Equipment	i/CA	CA	CA	EC	CA		s/CA	EC
Electrical Power Monitoring and Control	All	i/CA, i/CC	CA	CA	CA	CA	CTA	a/CA	CTA
Lighting Control Stations	All	i/CA	CA, AE	CA	CA	CA	CTA	s/CA	CTA
Lighting Occupancy Sensors	All	i/CA	CA, AE	CA	CA	CA	CTA	s/CA	CTA
Lighting Daylight Sensors	All	i/CA	CA, AE	CA	CA	CA	CTA	s/CA	CTA
Transformers	Medium Voltage	i/CA	CA, AE	CA	CA, TCA	CA, TCA	CTA	a/CA	CTA
Transformers	Low Voltage Distribution	i/CA	CA	CA	CA, TCA	CA, TCA	CTA	a/CA	CTA
Switchboards	All	i/CA	CA	CA	CA	CA	CTA	s/CA	CTA
Panelboards	All	i/CA	CA	CA	CA	CA	CTA	s/CA	CTA
Enclosed Bus Assemblies	All	i/CA	CA	CA	CA	CA	CTA	s/CA	CTA
Electric Vehicle Charging	All	i/CA	CA	CA	CA	CA	CTA	s/CA	CTA
Electricity Metering	All	i/CA, i/CC	CA	CA	CA	CA	CTA	a/CA	CTA
Variable Frequency Controllers	All	i/CA, i/CC	CA	CA	CA	CA	CTA	s/CA	CTA
Photovoltaic Collectors	All	i/CA	CA, MSR AE	CA	CA, MSR	CA	CTA, MSR	s/CA	CTA
Emergency Generators and Transfer Switches	Generator and all ATS	i/CA	CA, AE	CA	CA, MSR	CA	CTA, MSR	s/CA, s/AE	CTA

Surge Protection for Electrical Power Circuits	All	i/CA	CA	CA	MSR	CA	CTA	CA	CTA
Lighting Fixtures	All		CA	MSR	MSR	CA	CTA	s/CA	CTA
UPS System	All		CA	CA / MSR	MSR	CA			
Central Battery	All		CA	CA / MSR	MSR	CA			

Abbreviations: A/E: Designer CA: Commissioning Authority TC: Trade Subcontractor providing equipment CC: Controls Contractor EC: Electrical Contractor CTA: Certified Testing Agency MC: Mechanical Contractor MSR: Manufacturer Service Representative TAB: Testing, Adjusting and Balancing contractor.

1.07 TEST INSTRUMENT SERVICE AND CALIBRATION

- A. Calibration Program and Accuracy:
 1. Certified Testing Agency shall have a calibration program that maintains applicable test instrumentation within rated accuracy in accordance with manufacturer’s recommendations and standard industry practice.
 2. The accuracy shall be traceable to the National Bureau of Standards (NBS) in an unbroken chain.
 3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: 6 months, maximum.
 - b. Laboratory instruments: 12 months.
 - c. Leased specialty equipment: 12 months (where accuracy is guaranteed by the lessor)
 4. Dated calibration labels shall be visible on test equipment.
- B. Safety and Precautions:
 1. Safety practices shall include, but are not limited to, the following requirements.
 - a. OSHA
 - b. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
 - c. Applicable State and local safety operating procedures.
 2. Acceptance tests shall be performed with apparatus de-energized, unless otherwise specified.
 3. Certified Testing Agency shall have a designated safety representative who shall be present on the Project and supervise operations with respect to safety.
 4. Circuits operating in excess of 600-volts between conductors shall have conductors shorted to ground by a hot-line grounded device UL approved for the purpose.
 5. Work shall not proceed until the safety representative has determined that it is safe to do so.
 6. Certified Testing Agency shall have available sufficient protective barriers and warning signs. The testing agency shall place the protective barriers and warning signs in close proximity to the area where testing is being performed.

C. DEFINITION OF TESTS

1. Preliminary Inspection and Tests: Visual inspections of electrical equipment, wire checks of factory wiring and any other preliminary work required to prevent delays during performance of electrical acceptance tests. Contractor shall verify connections shown on the Construction Documents and.
2. Electrical Startup Tests: Those inspections and tests required to show that the workmanship, methods, inspections, and materials used in erection and installation of the electrical equipment conforms to accepted engineering practices, IEEE Standards, the National Electrical Code, manufacturers instructions, and Electrical Work of this Contract, and to determine that the equipment involved may be energized for operational tests.
3. Operating Tests: Those tests performed on all electrical equipment installed as part of the Electrical Work of the Contract and under other sections of the Specifications, to show that the electrical equipment will perform the functions for which it was designed.

1.08 AUTHORIZED WITNESSES

- A. Perform all acceptance, startup and operating tests in the presence of the Construction Manager.
- B. Notify vendors and manufacturers of electrical equipment of the time of tests. Coordinate with them or their representatives to permit them to witness tests should they so request.

1.09 DATA TO BE RECORDED

- A. Maintain reproducible test data sheets showing results of tests described in the accepted test procedures. Provide reproducible data sheets, listing acceptable or specified test limits and values actually measured. Retain one copy of test data sheets at the site. Furnish four copies to the Construction Manager.
- B. Provide data sheets showing test set-up, equipment used, names of persons performing test, names of witnesses, date, location, and serial number of equipment under test. Test data sheets will be reviewed by the Construction Manager and accepted as submitted, or additional tests may be required. If additional tests are required because initial test results do not comply with Specifications, document the re-testing and submit as before at no additional cost to BSDA.

1.10 ACTION SUBMITTALS

- A. Submit proposed testing program and test procedures for review and approval by the Construction Manager before beginning any testing. Each procedure shall include the following as a minimum:
 1. Statement of procedure objective and scope.
 2. List of equipment required to set up and perform the procedure.
 3. List of equipment or services required from areas outside Contractor's control.
 4. List of prerequisite tests that need to be completed before the procedure can be performed.
 5. Description of the required procedure setup, including diagrams illustrating test equipment connections and identifying test points, where applicable.
 6. Step-by-step instructions for performing the procedure identifying the points where data is to be recorded and the limits for acceptable data, in accordance with referenced standards.
 7. Provisions for recording pertinent test conditions and environment at time of test.
 8. Instructions for recording data on data sheets and verifying that procedure steps have been completed.
- B. Test Report (Draft and Final)
 1. The draft and final test reports, shall include, but not be limited to, the following:
 - a. Summary of Project.
 - b. Description of equipment tested.
 - c. Description of test.

- d. List of test equipment used in calibration and calibration date.
 - e. Test results, including plots/graphs and actual readings/measurements taken including corrected values.
 - f. Conclusions and recommendations.
 - g. Appendix, including appropriate test forms.
 - h. All test reports shall be signed by the Construction Manager's authorized witness present at the test.
- 2. The final test report shall be bound and its contents certified.
 - 3. Furnish ten copies of the completed final test report to the Construction Manager no later than 15 days after completion of the inspection and testing.
- C. Instruments: Submit list of instruments and certification indicating that instruments that will be used for testing have been calibrated and their accuracy certified within a previous period of not more than one month. List types of instruments to be used, manufacturer, model, serial number, latest date of calibration, and calibration organization.

1.11 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and the resumes of the personnel proposed to be assigned to this Project.
- B. Data gathering check lists and forms.
- C. Product Test Reports: For each electrical equipment for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For products: from ICC-ES.
- E. Pretesting observation Reports: For products.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.12 CLOSEOUT SUBMITTALS

- A. Final Commissioning Data: For products to include in maintenance manuals.
- B. Final Commissioning Report Data: For systems and sub-systems to include in operation and maintenance manuals.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine, with Installer present, for compliance with requirements for installation tolerances and construction documents and other conditions affecting performance of the Work.
- B. Examine products before installation. Reject products that are damaged, incomplete installation, or incorrect application or installation.
- C. Proceed with commissioning only after unsatisfactory conditions have been corrected.

3.02 TESTING REQUIREMENTS

- A. Do not perform more than one high potential test on any conductor unless specifically authorized by the CM.
- B. Megger Tests

1. Megger readings specified are the minimum readings desired at an ambient temperature of 60-degrees Fahrenheit and at a relative humidity of less than 60-percent. When megger readings are taken at other than 60-degrees Fahrenheit, convert readings to equivalent values at 60-degrees Fahrenheit.
 2. When megger readings fall below the specified minimum values at 60-degrees Fahrenheit, devise some means of applying heat for drying out the equipment subject to the approval of the Construction Manager. If drying is to be done by applying an electric potential to a piece of equipment, do not exceed the continuous voltage or current ratings of the equipment being dried, directly or by induction.
- C. Continuity Tests: Perform continuity tests with a dc type device using a bell, buzzer, or multi-meter. Do not use telephones for continuity tests; use telephones only for communication.
- D. Restore all connections and equipment to operating conditions after testing has been completed.

3.03 TESTS ON CONDUCTORS RATED 600 VOLT AND BELOW

- A. General: Provide and record all power feeder and branch circuit conductor a continuity test and a megger test. Verify phase identification our each power feeder and branch circuit[.]
- B. Verify identification of all lighting circuits and branch circuits on panel directories and make operational checks on all lighting circuits and branch circuits to prove that the circuits perform all functions for which they are designed.
- C. Check all feeder and subfeeder cable connections for workmanship and conformance with standard practice by visual inspection.
- D. Visual and mechanical inspection
1. Conductors shall be inspected for physical damage and proper connection in accordance with single line diagram.
 2. Conductors connections shall be torque tested to manufacturer's recommended values.
- E. Connections: Isolate power conductor to be megger tested by opening switches or breakers at each end of cable before testing where such disconnecting means exists. Where cables are direct connected without a disconnecting means, do not disconnect cables: Test as connected.
- F. Megger Tests
1. Use a 1,000-volt megger for each megger test. Insulation resistance tests shall be performed at 1,000-volts dc for 30 seconds.
 2. Apply megger tests between each conductor and ground with the other two conductors in the conduit or cable grounded to the same ground. Test each conductor in the same manner.
 3. Minimum acceptable readings: For disconnected cables, 100-megohm.
 4. When insulation resistance is to be determined with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place, the insulation resistance when tested at 500-volts dc shall be no less than indicated in Table "Minimum Insulation Resistance".
- G. Acceptance: Cable that do not pass all inspections and tests shall be considered defective and must be replaced and retested.
- H. Records: Include the following information in test report on each power feeder and branch circuit cable rated below 600-volts:
1. Complete cable identification and description of isolation means.
 2. Megger readings, including converted values.
 3. Approximate average cable temperature.

Minimum Insulation Resistance	
Conductor or Circuit Size	Minimum Resistance

No. 14 & No. 12 AWG	1,000,000-ohms
20-ampere circuits & above	250,000-ohms

3.04 TESTS ON CONTROL WIRING

- A. General: Give each single conductor and multi-conductor control wire or cable a continuity tests and an insulation strength test. Verify identification of conductors.
- B. Connections: Disconnect and fan out conductors to be tested.
- C. Insulation Strength Tests
 - 1. Subject each control wire to a 500-volt, 60-Hertz test.
 - 2. Apply test between each conductor in a wire group and ground with all other conductors in the wire group grounded to the same ground. Use a test set having an accurate means of insuring 500-volt test voltage and provide a series resistance to limit fault when a ground is found. Hold test voltage only long enough to read instruments. Test each conductor in the same manner.
 - 3. Instead of the above insulation strength test, megger each control wire as specified for 600-volt and below power conductors.
 - 4. Acceptance: Control wiring conductors that do not pass all inspections and tests shall be considered defective and must be replaced and retested.
- D. Records: Include the following information in test report on each wire group.
 - 1. Wire and group identification.
 - 2. Type of test, insulation strength or megger.
 - 3. When megger testing is selected, include information as specified for conductors rated 600 volt and below.

3.05 TESTS ON TRANSFORMERS RATED 600 VOLTS AND BELOW

- A. General: Check continuity and correctness of connections of windings and give each winding a megger test.
 - 1. Visual and mechanical inspection
 - a. Inspect for physical damage.
 - b. Compare equipment nameplate information with latest single line diagram and report discrepancies to the Construction Manager.
 - c. Verify proper auxiliary device operation for components including, but not limited to, fans, indicators, and tap changer.
 - d. Check tightness of accessible bolted electrical joints in accordance with Table 3.7.1. Check hardware, bushings, and vibration mats.
 - e. Perform specific inspections and mechanical tests in accordance with the manufacturer's instructions.
- B. Connections: Isolate transformer by opening the line side circuit breaker and disconnect secondary conductors at panels. Tie conductors together on each winding.
- C. Megger Tests
 - 1. Use a 1,000-volt megger for megger tests on 480-volt windings and a 500-volt megger for megger tests on lesser voltage windings. Appropriate guard circuit shall be used under bushings.
 - 2. Apply a megger test between each transformer winding tied together and ground. Ground all windings not included in the test to the same ground. Winding resistance tests shall be made for each winding at nominal tap position. Perform a megger test of the secondary windings.
 - 3. Minimum acceptable readings: 480-volt winding to ground, 45-megohms: lesser voltage winding to ground, 30-megohms.

4. Hold all megger tests for at least one minute or until the reading maintains a constant value for 15 seconds.

D. Electrical tests

1. A dielectric absorption test shall be made winding to winding and winding to ground for ten minutes. The polarization index shall be computed.
2. A turn ratio test shall be performed between windings for all tap positions. The final tap setting shall be determined and set by the testing company upon completion of the ratio testing acceptable values.
3. AC over-potential test shall be made on all high and low voltage winding to ground.
4. Individual exciting current tests shall be performed on each phase in accordance with established procedure.
5. Perform special test and adjustments in accordance with the manufacturer's instructions for tap changer, fan and controls, and alarm functions.
6. Perform a double power factor excitation test with a 10-kV tester.
7. Perform a core ground test.
8. Test temperature control panel and verify alarm stages and interlock for shutdown.

E. Test values

1. Insulation resistance and absorption test voltage shall be in accordance with Table "Insulation Resistance Test Voltage". Results shall be temperature corrected.
2. The absorption test polarization index shall be above 2.0 unless an extremely high value is obtained at the end of 1 minute, that when doubled will not yield a meaningful value with the available test equipment.
3. AC high potential test voltage shall not exceed 75-percent of factory test voltage or Table "Insulation Resistance Test Voltage" for a one-minute duration. Evaluation shall be on go, no-go, basis; NEMA ST-20.
4. Power factor test values more than 3-percent shall be investigated.
5. Winding resistance test results shall compare within 1-percent of adjacent windings.
6. Turns ratio test results shall not deviate more than 0.50 percent from calculated ratio

- F. Acceptance: Transformers that do not pass all inspections and tests shall be considered deficient and shall be replaced and retested.

- G. Records: Make complete and accurate records of each test. Include the following in each test report:

1. Complete identification of transformer.
2. Megger readings, including converted values and ambient temperature at time of test.

Insulation Resistance Test Voltage	
Voltage Rating (Volts)	Test Voltage (Volts)
150 - 600	1,000
601 - 5,000	2,500
5,001 - 15,000	5,000

3. Values of insulation resistance (IR) less than manufacturer's minimum or kV plus 1 in megohms shall be investigated. Over-potential tests shall not proceed until IR levels are raised to specified minimum.
4. Over-potential test voltages shall be applied in accordance with ANSI C37.20c, Table "Overpotential Test Voltages".

Overpotential Test Voltages	
Rated kV	Test Voltage kV

	AC	DC
5	14.3	20.2
15	27.0	37.5
25	45.0	Consult manufacturer
35	60.0	Consult manufacturer

5. Test results are evaluated on a go, no-go basis by slowly raising the test voltage to the required value and applying the final test voltage for 1 minute.

Table 3.13.3 - Applied Potential Test Voltages	
Nameplate Winding Voltage Rating, Volts	Test Potential, kV
0 – 250	2.5
251 – 1,200	4
1,201 – 2,500	10
2,501 – 5,000	12
5,001 – 8,660	19
8,661 – 15,000	31

3.06 TESTS ON CIRCUIT BREAKERS, LOW VOLTAGE (MOLDED CASE)

- A. Visual and mechanical inspection
 - 1. Circuit breakers shall be checked for proper mounting, conductor size, and feeder designation.
 - 2. Operate circuit breakers to insure smooth operation.
 - 3. Inspect case for cracks and other defects.
 - 4. Check tightness of connection with torque wrench in accordance with manufacturer's instructions.

- B. Electrical tests
 - 1. Contact resistance shall be measured.
 - 2. Time-current characteristic tests shall be performed by passing 300 percent rated current through each pole separately. Trip time shall be determined.
 - 3. Instantaneous pickup current shall be determined by run-up or pulse method. Clearing times shall be within 4-cycles or less.
 - 4. Insulation resistance shall be determined pole to pole, across pole and pole to ground. Test voltage shall be 1,000-volts DC.

- C. Test Values
 - 1. Contact resistance shall be compared to adjacent poles and similar breaker. Deviations of more than 50-percent shall be investigated.
 - 2. Insulation resistance shall not be less than 50 megohms.
 - 3. All trip times shall fall within Table 3.17.1. Circuit breakers exceeding maximum 300-percent time (Column 5) shall be replaced.
 - 4. Instantaneous pickup current levels shall be within 20-percent of manufacturer's published values.

Table 3.17.1 - Values for Overcurrent Trip Test (at 300% of Rated Continuous Current of Breaker)					
Tripping Time, Seconds					
Voltage for Volts Protection* (1)	Current, Amperes (2)	Range of Rated Continuous Thermal Breakers (3)	Magnetic Breakers Minimum (4)	Magnetic Breakers Maximum (5)	Maximum Tripping Times (6)
240	15 - 45	3	---	50	100
240	50 - 100	5	---	70	200
600	15 - 45	5	5	80	100
600	50 - 100	5	5	150	200
240	110 - 225	10	5	200	300
600	110 - 225	10	---	200	300
600	250 - 450	25	---	250	300
600	500 - 600	25	10	250	350
600	700 - 1,200	25	10	450	600
600	1,400 - 2,500	25	10	600	750

a. * These values are based on heat tests conducted by circuit breaker manufacturers on conductors in conduit.

3.07 TESTS ON INSTRUMENT TRANSFORMERS

- A. Visual and mechanical inspection
 - 1. Inspect for physical damage and compliance with the Drawings.
 - 2. Check mechanical clearances and proper operations of all disconnecting and grounding devices associated with potential transformers.
 - 3. Verify proper operation of grounding or shorting devices.
- B. Electrical tests
 - 1. Current transformers (CT) shall have secondary saturation tests done at a minimum of three points below and one point above knee of saturation curve.
 - 2. Confirm transformer polarity electrically.
 - 3. Burden tests shall be performed at the secondary leads of the CT to assure accurate translation of primary current.
 - 4. Verify connection at secondary CT leads by driving a low current through the leads and checking for this current at applicable devices.
 - 5. Confirm transformer ratio.
 - 6. Measure insulation resistance of transformer secondary and leads with 500 volt Megohm meter.
 - 7. Measure transformer primary insulation with applicable over-potential tests.
 - 8. Verify connection of secondary potential transformer (PT) leads by applying a low voltage to the leads and checking for this voltage at applicable devices.
 - 9. Check for PT secondary load with secondary voltage and current measurements. Load shall less than voltage ampere capacity of the PT.

3.08 TESTS ON METERING AND INSTRUMENTATION

- A. Visual and mechanical inspection
 - 1. Examine devices for broken parts, indication of shipping damage and wire connection tightness.
 - 2. Verify meter connections in accordance with single line meter and relay diagram.
- B. Electrical tests
 - 1. Calibrate all meters at mid scale. Calibration instrument precision shall be 50-percent or less than the precision of the instrument being tested. (If the instrument being tested has a precision of plus or minus 10-percent, the precision of the calibration instrument shall be plus or minus 5-percent or better.)
 - 2. Calibrate watt-hour meters to 0.50-percent.
 - 3. Verify instrument multipliers.
- C. Acceptance: Grounding materials and connections must pass all inspections and must meet all specified maximum and minimum values.
- D. Records: Make complete records of all tests. Include resistance values obtained, calculations of same, and methods of test and calculation.

3.09 TESTS ON GROUNDING SYSTEMS

- A. General: Inspect ground conductors, ground buses, and connections for conformance with design specifications and for satisfactory workmanship. Test resistance to earth of each ground rod. Test ground paths for equipment and structural steel or reinforcing bar grounding.
 - 1. Visual and mechanical inspection: Inspect ground system for compliance with the Drawings and specifications.
- B. Connections
 - 1. Maintain each ground rod isolated from the associated ground rods for tests on individual rods for resistance to earth.
 - 2. Include associated ground rods and interconnecting wiring in test for resistance to earth.
 - 3. Include ground bus on equipment, room and pullbox connections, and associated intermediate copper ground conductors in tests on ground paths for electrical equipment.
 - 4. Include structural steel or reinforcing bar connection, rod connection and intermediate conductor in tests on ground paths for structural steel or reinforcing bars.
- C. Electrical tests
 - 1. Perform fall of potential test in accordance with IEEE 81, Section 9.04, on the main grounding electrode or system.
 - 2. Perform the two-point method test in accordance with IEEE 81, to determine the ground resistance between the main grounding system and major electrical equipment frames, system neutral, and/or derived neutral points.
 - a. Alternate method: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of 10 amperes DC current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.
 - 3. Tests on Individual Ground Rods
 - a. Test each ground rod for resistance to earth by a standard method. Use a Biddle Ground Tester (AVO International) or the method of using two auxiliary ground rods as described in IEEE. The IEEE method requires the use of ac test current. Place auxiliary test rods sufficiently far away from the rod under test so that the regions in which their resistance is localized do not overlap. Calculate ground resistance from the readings taken. Maximum acceptable resistance to earth: 2-ohms.

- b. If the resistance is found to be higher than 2-ohms, drive additional rods with a minimum separation of 20-feet and connect in parallel with the rod under test until 2-ohms or less is obtained, or increase the length of the rod under test until 2-ohms maximum is obtained.

D. Tests of same, and methods of test and calculation.

3.10 TESTS ON SURGE ARRESTORS

- A. Visual and mechanical inspection
 - 1. Inspect for physical damage.
 - 2. Verify location and nameplate rating with the Drawings and the specifications.
 - 3. Inspect ground and discharge counter connections for integrity.
- B. Electrical tests
 - 1. Perform a 60-Hertz sparkover test.
 - 2. Perform a radio influence voltage (RIV) test.
 - 3. Perform an insulation power factor test.
 - 4. Perform ground continuity test to ground grid system.
- C. Test values
 - 1. Sparkover voltage shall:
 - a. Exceed 1.5 times rating.
 - b. Not exceed 2.0 times rating.
 - 2. Radio influence voltage (RIV) shall not be detected within voltage rating of arrester.
 - 3. Power factor tests shall show similar dielectric loss between similar arrests.
 - 4. Ground grid connections shall not exceed 0.5-ohms, maximum.

3.11 TESTS ON LIGHTING SYSTEMS – STATION AND BUILDINGS

- A. Perform operation tests for complete lighting system including switches, emergency lighting, and receptacles.

3.12 SYSTEM FUNCTION TESTS

- A. General
 - 1. Each system specified shall be function tested to confirm total system operation.
 - 2. Upon completion of equipment tests, the system functional tests shall be performed. System functional tests shall show the proper interaction of sensing, processing, and action devices to effect the design end-product or results.
 - 3. Implementation
 - a. The testing company shall develop a test matrix that includes, but is not limited to, the following:
 - 1) Input signal or stimuli. Example: Current transformers; potential transformers.
 - 2) Decision process. Example: Pilot Wire Relay System
 - 3) Action device. Example: Circuit Breaker - ACB
 - 4) End product or result. Example: Zone Fault Protection
 - b. All interlocks safety devices and fail-safe functions shall be tested in addition to design function.
 - c. The testing company shall propose methods to initiate the sensing device by physical stimuli and quantitatively monitor the result or output by measurement. DEMONSTRATION
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

**SECTION 26 0923
LIGHTING CONTROL DEVICES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Photoelectric switches.
 2. Indoor occupancy sensors.
 3. Outdoor motion sensors.
- B. Related Requirements:
 1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.
 2. Section 260943.16 "Addressable-Luminaire Lighting Controls"
 3. Section 260943.23 "Relay Based Lighting Controls"

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 1. Interconnection diagrams showing field-installed wiring.
 2. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Leviton Manufacturing Co., Inc.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: SPST.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.

6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.02 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Industries, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. NSi Industries LLC.
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 3. Time Delay: Fifteen second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.03 DAYLIGHT-HARVESTING SWITCHING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Industries, Inc.
 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 3. Sensor Switch, Inc.
 4. WattStopper; a Legrand® Group brand.
- B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- C. Electrical Components, Devices, and Accessories:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.
 6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.
 7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.
 8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
 9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
 10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
 11. Control Load Status: User selectable to confirm that load wiring is correct.

12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.04 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 4. WattStopper; a Legrand® Group brand.
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
 3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
 4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

2.05 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 3. Lutron Electronics Co., Inc.
 4. Sensor Switch, Inc.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.06 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Leviton Manufacturing Co., Inc.
 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 3. Lutron Electronics Co., Inc.
 4. Sensor Switch, Inc.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application[, **and shall comply with California Title 24**].
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor Tag WS1:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 4. Voltage: Match the circuit voltage; dual-technology type.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
- D. Wall-Switch Sensor Tag WS2:
1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
 2. Sensing Technology: PIR.
 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 4. Voltage: Match the circuit voltage; dual-technology type.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.07 OUTDOOR MOTION SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Industries, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 4. Sensor Switch, Inc.
 5. WattStopper; a Legrand® Group brand.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Dual-technology (PIR and infrared) type, weatherproof. Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
 3. Switch Rating:
 - a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent 250-W LED.
 - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 4. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off." With bypass switch to override the "on" function in case of sensor failure.
 5. Voltage: Match the circuit voltage type.
 6. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
 - b. Long Range: 180-degree field of view and 110-foot (34-m) detection range.
 7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 9. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
 11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

2.08 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.02 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.03 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.04 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.07 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 0943
RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes: Lighting control panels using mechanically held relays for switching.
- B. Section Includes: Networked lighting control panels using control-voltage relays for switching and that are interoperable with HVAC DDC system.

1.03 DEFINITIONS

- A. BAS: Building automation system.
- B. DDC: Direct digital control.
- C. IP: Internet protocol.
- D. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 3. Sound data including results of operational tests of central dimming controls.
 4. Operational documentation for software and firmware.
- B. Shop Drawings: For each relay panel and related equipment.
 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 3. Detail wiring partition configuration, current, and voltage ratings.
 4. Short-circuit current rating of relays.
 5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
 6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
 7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
 8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - 1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
 - 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.
- B. Qualification Data: For testing agency.
- C. Field quality-control reports.
- D. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- E. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB drive.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Testing and adjusting of panic and emergency power features.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lighting Control Relays: Equal to 10 percent of amount installed for each size indicated, but no fewer than 3.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation according to NECA 407.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of standalone multipreset modular dimming controls that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
 - 3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.
- B. Interface with HVAC DDC System: Hardware and software shall interface with HVAC DDC system to monitor, control, display, and record data for use in processing reports. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - 1. Hardwired Points:
 - a. Monitoring: On-off status,.
 - b. Control: On-off operation,.
 - 2. Communication Interface: Comply with ASHRAE 135. The communication interface shall enable the HVAC DDC system operator to remotely control and monitor lighting from a HVAC DDC system operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the HVAC DDC system. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."
- C. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- F. Comply with UL 916.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Lighting control panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5.

2.03 LIGHTING CONTROL RELAY PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. WattStopper; Legrand North America, LLC
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- C. Lighting Control Panel:
 - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.
- D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
 - 1. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.

- c. Four independent schedules, each having 24 time periods.
- d. Schedule periods settable to the minute.
- e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
- f. 10 special date periods.
- 2. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blink warning" shall warn occupants approximately five minutes before actuating the off sequence.
- 3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.
- E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire, 24-V ac.
- F. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating shall be not less than 14 kA. Control shall be three-wire, 24-V ac.
- G. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.
- H. Operator Interface:
 - 1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
 - 2. Log and display relay on-time.
 - 3. Connect relays to one or more time and sequencing schemes.

2.04 NETWORKED LIGHTING CONTROL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. WattStopper; Legrand North America, LLC
 - 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.
- C. Lighting Control Panels:
 - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.
- D. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
 - 1. Ethernet Communications: Comply with TCP/IP protocol. The main control unit shall provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
 - 2. Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.

3. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
 - a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
 - b. Panel summary showing the master and slave panels connected to the controller.
 - c. Controller diagnostic information.
 - d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens shall also allow direct breaker control and zone overrides.
 4. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Four independent schedules, each having 24 time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. 16 special date periods.
 5. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blinking warning" shall warn occupants approximately five minutes before actuating the off sequence.
 - e. Activity log, storing previous relay operation, including the time and cause of the change of status.
 - f. Download firmware to the latest version offered by manufacturer.
- E. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.
1. Electronic control for operating and monitoring individual relays, and display relay on-time.
 2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
 3. Integral keypad and digital-display front panel for local setup, including the following:
 - a. Blink notice, time adjustable from software.
 - b. Ability to log and display relay on-time.
 - c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.
- F. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be digital control network.
- G. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating shall be not less than 14 kA. Control shall be digital control network.
- H. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.
- I. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup

software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device shall remain the property of Owner.

- J. Software:
 1. Menu-driven data entry.
 2. Online and offline programming and editing.
 3. Provide for entry of the room or space designation for the load side of each relay.
 4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
 5. Size the software appropriate to the system.

2.05 MANUAL SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
 1. Match color and style specified in Section 262726 "Wiring Devices."
 2. Integral green LED pilot light to indicate when circuit is on.
 3. Internal white LED locator light to illuminate when circuit is off.
- B. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."
- C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.06 FIELD-MOUNTED SIGNAL SOURCES

- A. Daylight Harvesting Switching Controls: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.
- B. Indoor Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.07 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Twisted-Pair Data Cable: Category 6. Comply with requirements for twisted pair cabling in Section 260523 "Control-Voltage Electrical Power Cables."
- E. Twisted-Pair Data Cable: Category 6. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.03 PANEL INSTALLATION

- A. Comply with NECA 1.
- B. Install panels and accessories according to NECA 407.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- E. Mount panel cabinet plumb and rigid without distortion of box.
- F. Install filler plates in unused spaces.

3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers described below. Certify compliance with manufacturer's test parameters.
 - a. Circuit-Breaker Tests:
 - 1) Compare nameplate with Drawings and Specifications.
 - 2) Inspect physical and mechanical conditions.
 - 3) Inspect anchorage and alignment.
 - 4) Verify that the units are clean.
 - 5) Operate the circuit breaker to ensure smooth operation.
 - 6) Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - a) A low-resistance ohmmeter.
 - b) Verify tightness of bolted electrical connections by calibrated torque wrench.
 - c) Thermographic survey.
 - 7) Inspect operating mechanism, contacts, and arc chutes in unsealed units.
 - 8) Perform adjustments for final protective device settings according to the overcurrent protective device coordination study. Comply with requirements in Section 260573.16 "Coordination Studies."
 - 9) Perform insulation resistance tests for one minute on each pole, phase-to-phase, and phase-to-ground with the circuit breaker closed and across each pole using manufacturer's published data.
 - 10) Perform a contact/pole-resistance test.
 - 11) Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be for one minute. Follow manufacturer's written instructions for solid-state units.
 - 12) Determine long-time pickup and delay by primary current injection.
 - 13) Determine short-time pickup and delay by primary current injection.
 - 14) Determine ground-fault pickup and time delay by primary current injection.
 - 15) Determine instantaneous pickup by primary current injection.
 - 16) Test functions of the trip unit by means of secondary injection.
 - 17) Perform minimum pickup voltage tests on shunt trip and close coils according to manufacturer's published data.
 - 18) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset trip logs and indicators.
 - 19) Verify operation of charging mechanism.
 - b. Surge Arrestor Tests:
 - 1) Compare nameplate with the Contract Documents.
 - 2) Inspect physical and mechanical conditions.
 - 3) Inspect anchorage, alignment, grounding, and clearances.
 - 4) Verify that the units are clean.
 - 5) Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - a) Low-resistance ohmmeter.
 - b) Verify tightness of bolted electrical connections by calibrated torque wrench.
 - 6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
 - 7) Perform an insulation-resistance test on each arrester, phase terminal-to-ground using voltage according to manufacturer written instructions.
 - 8) Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding tests.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

F. Lighting control panel will be considered defective if it does not pass tests and inspections.

- G. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

3.07 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.08 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION

**SECTION 26 2416
PANELBOARDS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Distribution panelboards.
 2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 1. Include dimensioned plans, elevations, sections, and details.
 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 4. Detail bus configuration, current, and voltage ratings.
 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 8. Include wiring diagrams for power, signal, and control wiring.
 9. Key interlock scheme drawing and sequence of operations.
 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.
- C. Delegated Design Submittal:
 1. For arc-flash hazard study.

2. For arc-flash labels.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing..
- B. Provide ¼" scale drawing demonstrating that installation has been coordinated with work of other trades. Use actual dimensions from approved equipment submittals to coordinate layout and installation of transformers and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet (2000 m).

- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Owner's written permission.
 3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Height: 90 inches (2286 mm) to top of trim maximum.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 4. Skirt for Surface-Mounted Panelboards (located in Public Areas): Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- G. Incoming Mains:
 1. Location: Convertible between top and bottom.
 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

- H. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
- J. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - 1. Percentage of Future Space Capacity: 50 percent.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings calculated in Section 260573 Short-Circuit Study, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings calculated in Section 260573.13 Short-Circuit Study, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.03 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.

- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only as indicated on schedule.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents [calculated in Section 260573.13 Short-Circuit Study].
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.

- g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 6. AFCI-Arc Fault Circuit Interrupter Circuit Breaker for Residential Units.
- 7. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - k. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - l. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - m. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - n. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - o. Multipole units enclosed in a single housing with a single handle.
 - p. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - q. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.06 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
 - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.

- K. Install overcurrent protective devices and controllers not already factory installed.
 1. Set field-adjustable, circuit-breaker trip ranges.
 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- P. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

- b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
- c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Coordination Studies."

3.06 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 2713
ELECTRICITY METERING – M&V

PART 1 - GENERAL**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes electricity metering.

1.03 DEFINITIONS

- A. KY or KYZ Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity (kWh) that is based on a relay opening and closing in response to the rotation of the disk in the meter. Electronic meters generate pulses electronically.

1.04 ACTION SUBMITTALS

- A. Product Data:
1. For each type of meter.
 2. For metering infrastructure components.
 3. For metering software.
- B. Shop Drawings: For electricity-metering equipment.
1. Include elevation views of front panels of control and indicating devices and control stations.
 2. Include diagrams for power, signal, and control wiring.
 3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 4. Include series-combination rating data for modular meter centers with main disconnect device.
 5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.05 INFORMATIONAL SUBMITTALS

- A. Provide ¼" scale drawing demonstrating that installation has been coordinated with work of other trades. Use actual dimensions from approved equipment submittals to coordinate layout and installation of electrical distribution equipment, transformers, panels and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Qualification Data: For testing agency.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Application and operating software documentation.
 2. Software licenses.
 3. Software service agreement.
 4. Device address list.
 5. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy Submittal.
 6. Meter data sheet for each meter, listing nameplate data and serial number, accuracy certification, and test results.
 7. Meter installation and billing software startup report.

1.07 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Construction Manager shall be notified and issued written permission no fewer than five days in advance of proposed interruption of electrical service.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Loss of communication with metering equipment.
 - b. Accuracy out of specified range.
 - c. Damage from transient voltage surges.
 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
 3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 916.

2.02 ELECTRICITY METERS

- A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton.
 2. E-Mon.
 3. General Electric Company.
 4. Leviton Manufacturing Co., Inc.

5. SIEMENS Industry, Inc.; Energy Management Division.
 6. Square D; by Schneider Electric.
 7. Comply with ANSI C12.1 and ANSI C12.20, 0.5 accuracy class.
 8. Ambient Temperature: Minus 22 deg F to plus 158 deg F (Minus 30 deg C to plus 70 deg C).
 9. Humidity: Zero to 95 percent, noncondensing.
- C. General Requirements for Meters:
1. Meters Certification: Certified by California Type Evaluation Program as complying with 4 CCR 4027, Article 2.2.
 2. Certify that meters comply with ANSI C12.20 requirements by a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The laboratory shall use test equipment that is certified annually and is traceable to NIST standards.
 3. Enclosure: Supplied by meter manufacturer, NEMA 250, Type 1 or Type 3R minimum, with provisions for locking or sealing.
 4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
 5. Onboard Nonvolatile Data Storage: kWh, until reset.
 6. Sensors: Current-sensing type, supplied by electronic meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
 - a. Type: solid core, complying with recommendation of meter manufacturer.
- D. kWhd Meter: Electronic single-phase and three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating the following:
 - a. Accumulative kWh.
 - b. Current time and date.
 - c. Current demand.
 - d. Historic peak demand.
 - e. Time and date of historic peak demand.
 3. Retain accumulated kWh and historic peak demand in a nonvolatile memory, until reset.
- E. KY and KYZ Pulse Totalizer:
- F. Remote Reading Options:
1. Pulse Output: KYZ, complete with optical sensor and interface devices.
 2. Serial Interface: RS-232.
 3. Serial Interface: RS-485, with Modbus RTU protocol.
 4. USB interface.
 5. TCP/IP adapter.
- G. Current-Transformer Cabinet: Size and configuration as recommended by metering equipment manufacturer for use with indicated connected feeder and sensors.
- H. Data Transmission Cable: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install modular meter center according to switchboard installation requirements in NECA 400.

- C. Install arc-flash labels as required by NFPA 70.
- D. Wiring Method:
 1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 271513 "Communications Copper Horizontal Cabling."
 3. Minimum conduit size shall be 1/2 inch (13 mm).

3.02 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
 2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 1. Equipment and Software Setup:
 - a. Set meter date and time clock.
 - b. Test, calibrate, and connect pulse metering system.
 - c. Set and verify billing demand interval for demand meters.
 - d. Report settings and calibration results.
 - e. Set up reporting and billing software, insert billing location names and initial constant values and variable needed for billing computations.
 2. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 3. Turn off circuits supplied by metered feeder and secure them in off condition.
 4. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
 6. Generate test report and billing for each tenant or activity from the meter reading tests.
- E. Electricity metering will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.04 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's clerical and maintenance personnel to use, adjust, operate, and maintain the electronic metering and billing software.

END OF SECTION

**SECTION 26 2726
WIRING DEVICES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Straight-blade convenience, isolated-ground, and tamper-resistant receptacles.
 2. GFCI receptacles.
 3. Toggle switches.
 4. Wall plates.
 5. Floor service outlets.
 6. Poke-through assemblies.
 7. Prefabricated multioutlet assemblies.

1.03 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
 1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
 3. Leviton: Leviton Mfg. Company, Inc.
 4. Pass & Seymour: Pass& Seymour/Legrand.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.
- H. UTP: Unshielded twisted pair.

1.04 ACTION SUBMITTALS

- A. Samples: One for each type of device and wall plate specified, in each color specified.

1.05 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
- B. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.03 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, non-feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).

- b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
- C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand (Pass & Seymour).

2.04 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
- 1. Single Pole:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Two Pole:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).
- C. Pilot-Light Switches: 120/277 V, 20 A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: Single pole, with LED-lighted handle, illuminated when switch is off.
- D. Key-Operated Switches: 120/277 V, 20 A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.05 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
- 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.06 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Data Communication Outlet: [Blank cover with bushed cable opening.] [Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."]

2.07 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Pass & Seymour/Legrand (Pass & Seymour).
 3. Square D; by Schneider Electric.
 4. Wiremold / Legrand.
- B. Description:
 1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
 2. Comply with UL 514 scrub water exclusion requirements.
 3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."
 4. Size: Selected to fit nominal **8-inch (200-mm)** cored holes in floor and matched to floor thickness.
 5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 6. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.
 7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.08 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Wiremold / Legrand.
- B. Description:
 1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
 2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: [Metal, with manufacturer's standard finish] [PVC].
- D. Multioutlet Harness:
 1. Receptacles: 20-A, 125-V, NEMA WD 6 Configuration 5-20R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
 2. Receptacle Spacing: 12 inches (300 mm) [**18 inches (460 mm)**].

3. Wiring: No. 12 AWG solid, Type THHN copper, multi circuit, connecting alternating receptacles.

2.09 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.
 3. SPD Devices: Blue.
 4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.

- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
 - 1. Install dimmers within terms of their listing.
 - 2. Verify that dimmers used for fan-speed control are listed for that application.
 - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

- A. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Perform the following tests and inspections:
 - 1. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 26 2813**FUSES****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.
 2. Spare-fuse cabinets.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 5. Coordination charts and tables and related data.
 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 4. Coordination charts and tables and related data.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.06 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Bussmann, an Eaton business.
 2. Edison; a brand of Bussmann by Eaton.
 3. Littelfuse, Inc.
 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.03 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK1 Class RK5, time delay.
 - 2. Other Branch Circuits: Class RK1, time delay Class RK5, time delay.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 2816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case switches.
 - 4. Enclosures.

1.03 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.08 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.02 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.03 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB Inc.
 2. Eaton.
 3. General Electric Company.
 4. SIEMENS Industry, Inc.; Energy Management Division.
 5. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
 1. Single throw.
 2. Three pole.
 3. 600-V ac.
 4. 1200 A and smaller.
 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 240-V ac.
 2. Hookstick Handle: Allows use of a hookstick to operate the handle.
 3. Lugs: Mechanical type, suitable for number, size, and conductor material.
 4. Service-Rated Switches: Labeled for use as service equipment.

2.04 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton.
 2. General Electric Company.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.

- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
 1. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 240-V ac.
 2. Hookstick Handle: Allows use of a hookstick to operate the handle.
 3. Lugs: Mechanical type, suitable for number, size, and conductor material.
 4. Service-Rated Switches: Labeled for use as service equipment.

2.05 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12) [copper-free cast aluminum alloy (NEMA 250 Types 7, 9)].
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

3.03 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.04 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.05 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.06 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections[with the assistance of a factory-authorized service representative].
- C. Tests and Inspections for Switches:
1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- D. Tests and Inspections for Molded Case Circuit Breakers:
 - 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

- c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 - E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
 - F. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- 3.07 ADJUSTING**
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
 - B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 26 2913
MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Manual motor controllers.
 2. Enclosed full-voltage magnetic motor controllers.
 3. Combination full-voltage magnetic motor controllers.
 4. Enclosures.
 5. Accessories.
 6. Identification.

1.03 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of magnetic controller.
 1. Include plans, elevations, sections, and mounting details.
 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
 3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Product Schedule: List the following for each enclosed controller:
 1. Each installed magnetic controller type.
 2. NRTL listing.
 3. Factory-installed accessories.
 4. Nameplate legends.
 5. SCCR of integrated unit.

6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
 - a. Listing document proving Type 2 coordination.
7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for magnetic controllers, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for magnetic controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
 - d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
 - e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: Two of each type and color installed.
 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 Wper controller.

1.09 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than 23 deg F (minus 5 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m) for electromagnetic and manual devices.
 3. The effect of solar radiation is not significant.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.
- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.

2.02 MANUAL MOTOR CONTROLLERS

- A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. General Electric Company.
 - c. Rockwell Automation, Inc.
 - d. SIEMENS Industry, Inc.; Energy Management Division.
 - e. Square D; by Schneider Electric.
 2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
 3. Configuration: Nonreversing.
 4. Surface mounting.
 5. Red pilot light.
- B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. General Electric Company.
 - c. Rockwell Automation, Inc.
 - d. SIEMENS Industry, Inc.; Energy Management Division.
 - e. Square D; by Schneider Electric.
 2. Configuration: Nonreversing.
 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 4. Pilot Light: Red.

- C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. General Electric Company.
 - c. Rockwell Automation, Inc.
 - d. SIEMENS Industry, Inc.; Energy Management Division.
 - e. Square D; by Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Overload Relays: NEMA ICS 2, bimetallic class as scheduled on Drawings.

2.03 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Rockwell Automation, Inc.
 - 4. SIEMENS Industry, Inc.; Energy Management Division.
 - 5. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Contactor Coils: Pressure-encapsulated type.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Overload Relays:
 - 1. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

2.04 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Rockwell Automation, Inc.
 - 4. SIEMENS Industry, Inc.; Energy Management Division.

5. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Contactor Coils: Pressure-encapsulated type.
 1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Overload Relays:
 1. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- G. MCP Disconnecting Means:
 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- H. MCCB Disconnecting Means:
 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.05 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.06 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
 1. Comply with requirements in Section 260574 "Overcurrent Protective Device Arc-Flash Study." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1) Location designation.
 - 2) Nominal voltage.
 - 3) Flash protection boundary.
 - 4) Hazard risk category.

- 5) Incident energy.
 - 6) Working distance.
 - 7) Engineering report number, revision number, and issue date.
- b. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.02 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect contactors:
 - 1) Verify mechanical operation.
 - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
 - f. Motor-Running Protection:
 - 1) Verify overload element rating is correct for its application.
 - 2) If motor-running protection is provided by fuses, verify correct fuse rating.

- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
3. Electrical Tests:
- a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
 - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - c. Test motor protection devices according to manufacturer's published data.
 - d. Test circuit breakers as follows:
 - 1) Operate the circuit breaker to ensure smooth operation.
 - 2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
 - e. Perform operational tests by initiating control devices.
- D. Motor controller will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.05 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
 - 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

3.06 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION

SECTION 26 2923
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Related Requirements:
 - 1. Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.

1.03 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. LED: Light-emitting diode.
- F. NC: Normally closed.
- G. NO: Normally open.
- H. OCPD: Overcurrent protective device.
- I. PID: Control action, proportional plus integral plus derivative.
- J. RFI: Radio-frequency interference.
- K. VFC: Variable-frequency motor controller.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each VFC indicated.
 - 1. Include mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Required working clearances and required area above and around VFCs.

2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

- C. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.
1. Certificate of compliance.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
 - b. Manufacturer's written instructions for setting field-adjustable overload relays.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
 - f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Indicating Lights: Two of each type and color installed.
3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Low Voltage HVAC Drives.
 - 2. Eaton.
 - 3. Schneider Electric USA, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.
 - 5. Yaskawa Electric America, Inc.

2.02 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
 - 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- B. Application: Constant torque and variable torque.
- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 - 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 - 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
 - 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 - 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 - 4. Minimum Efficiency: 97 percent at 60 Hz, full load.
 - 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
 - 6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
 - 7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
 - 8. Humidity Rating: Less than 95 percent (noncondensing).
 - 9. Altitude Rating: Not exceeding 3300 feet (1000 m).
 - 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
 - 11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 - 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 - 13. Speed Regulation: Plus or minus 5 percent.
 - 14. Output Carrier Frequency: Selectable; 0.5 to 12 kHz.
 - 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
 - 1. Signal: Electrical.
- I. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 0.1 to 999.9 seconds.
 - 4. Deceleration: 0.1 to 999.9 seconds.
 - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:
 - 1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 - 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 - 3. Under- and overvoltage trips.
 - 4. Inverter overcurrent trips.
 - 5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 - 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 - 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 8. Loss-of-phase protection.
 - 9. Reverse-phase protection.
 - 10. Short-circuit protection.
 - 11. Motor-overtemperature fault.

- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
 - 1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
 - 2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 - 3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
 - 4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 - 5. NO alarm contact that operates only when circuit breaker has tripped.

2.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.04 CONTROLS AND INDICATION

- 1. Power on.
 - 2. Run.
 - 3. Overvoltage.
 - 4. Line fault.
 - 5. Overcurrent.
 - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
 - C. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- F. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
1. Hardwired Points:
 - a. Monitoring: On-off status,.
 - b. Control: On-off operation,.
 2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.05 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total

harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

- B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.06 OPTIONAL FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications when overload protection activates.
 - 1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.
 - 2. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.
 - 3. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.
- B. Damper control circuit with end-of-travel feedback capability.
- C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.
- D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.
- E. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- F. Remote digital operator kit.
- G. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer.

2.07 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.08 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons: Covered Shielded.
 - 2. Pilot Lights: Push to test.
 - 3. Selector Switches: Rotary type.
 - 4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- E. Supplemental Digital Meters:
 - 1. Elapsed-time meter.
 - 2. Kilowatt meter.
 - 3. Kilowatt-hour meter.
- F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- H. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.
- I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- J. Spare control-wiring terminal blocks; unwired.

2.09 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
 - 1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
 - 2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."
- C. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch VFC.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

3.03 CONTROL WIRING INSTALLATION

- A. Bundle, train, and support wiring in enclosures.
- B. Connect selector switches and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.04 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. VFCs will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.07 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."
- F. Set field-adjustable pressure switches.

3.08 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 26 4313

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:
 1. Section 262413 "Switchboards" for factory-installed SPDs.
 2. Section 262416 "Panelboards" for factory-installed SPDs.

1.03 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.05 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.07 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.02 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Current Systems.
 - 3. Eaton.
 - 4. Liebert; a brand of Vertiv.
 - 5. Schneider Electric USA, Inc.
- B. SPDs: Comply with UL 1449, Type 1 and/or Type 2.
- C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1 and/or Type 2
 - 1. SPDs with the following features and accessories:
 - a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - b. Indicator light display for protection status.
 - c. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - d. Surge counter.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 208Y/120 V.
 - 3. Line to Line: 1000 V for 208Y/120 V.
- F. SCCR: Equal or exceed 200 kA.
- G. Inominal Rating: 20 kA.

2.03 PANEL SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Current Systems.
 - 3. Eaton.
 - 4. Liebert; a brand of Vertiv.
 - 5. Schneider Electric USA, Inc.

- B. SPDs: Comply with UL 1449, Type 1 and/or Type 2.
 - 1. Include LED indicator lights for power and protection status.
 - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - 3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and/or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 700 V for 208Y/120 V.
 - 3. Neutral to Ground: 700 V for 208Y/120 V.
 - 4. Line to Line: 200 V for 208Y/120 V
- E. SCCR: Equal or exceed 200 kA.
- F. Inominal Rating: 20 kA.

2.04 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

2.05 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.

2. Inspect anchorage, alignment, grounding, and clearances.
 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.03 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 26 5119
LED INTERIOR LIGHTING

PART 1 - GENERAL**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes the following types of LED luminaires:
1. Cylinder.
 2. Downlight.
 3. Linear industrial.
 4. Recessed, linear.
 5. Strip light.
 6. Surface mount, linear.
 7. Surface mount, nonlinear.
 8. Suspended, linear.
 9. Suspended, nonlinear.
- B. Related Requirements:
1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.
 3. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.03 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Arrange in order of luminaire designation.
 2. Include data on features, accessories, and finishes.
 3. Include physical description and dimensions of luminaires.
 4. Include emergency lighting units, including batteries and chargers.
 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 6. Photometric data and adjustment factors based on laboratory tests[, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project] [IES LM-79] [and] [IES LM-80].

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
- 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
- 1. Product Data: Indicating luminaire is certified by ENERGY STAR Design Lights Consortium.
- D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
 - 4. Structural members to which equipment and or luminaires will be attached.
 - 5. Initial access modules for acoustical tile, including size and locations.
 - 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
 - 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of luminaire.
- E. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."
- C. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
 - 1. Relative Humidity: Zero to 95 percent.
- D. Altitude: Sea level to 1000 feet (300 m).

2.02 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

2.03 LUMINAIRE SCHEDULE

- A. Refer to the schedule shown on the plans

2.04 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 - 1. 1. Manufacturer's standard grade.
 - 2. 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.05 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.06 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
 - 1. Ceiling Mount:
 - a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 10 feet (3 m) in length.

- b. Pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 10 feet (3 m) in length.
 - c. Hook mount.
 - 2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
- 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.07 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

**SECTION 26 5619
LED EXTERIOR LIGHTING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 2. Luminaire supports.
 3. Luminaire-mounted photoelectric relays.
- B. Related Requirements:
 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 2. Section 260926 "Lighting Control Panelboards" for panelboard-based lighting control.
 3. Section 260943 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
 4. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.03 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 1. Arrange in order of luminaire designation.
 2. Include data on features, accessories, and finishes.
 3. Include physical description and dimensions of luminaire.
 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 6. Wiring diagrams for power, control, and signal wiring.

7. Photoelectric relays.
 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
1. BUG Ratings: Product Data including BUG ratings of all installed exterior luminaires.
 2. Luminaire Calculations: Product Data including lumen emittance and vertical illuminance
 3. Product Data: Indicating luminaire is certified by ENERGY STAR.
- D. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- E. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Structural members to which equipment and luminaires will be attached.
 3. Underground utilities and structures.
 4. Existing underground utilities and structures.
 5. Above-grade utilities and structures.
 6. Existing above-grade utilities and structures.
 7. Building features.
 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
1. Luminaire.
 2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Source quality-control reports.
- G. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.

- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 80. CCT of 3500K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac 277 V ac.
- L. In-line Fusing: Separate in-line fuse for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- N. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.03 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Lighting, an Eaton business.
 - 2. Eaton.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-

second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.04 LUMINAIRE SCHEDULE

- A. Refer to the schedule shown on the plans

2.05 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum Epoxy-coated steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Glass: Annealed crystal glass unless otherwise indicated.
 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.06 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: Per architect.

- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.

2.07 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.04 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.05 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.06 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.09 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 27 0000
BASIC COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Scope of Work
 2. Contractor Qualifications
 3. System Performance Warranty
 4. Safety
 5. Working Conditions.
 6. Coordination
 7. Action Submittals
 8. SCCS components
 9. Delivery and Storage
 10. Informational Submittals
 11. Closeout Submittals
 12. Quality Assurance

1.02 RELATED DOCUMENTS

- A. All divisions of the specification and general provisions of the Construction Documents.
- B. Architectural, mechanical, electrical, and all technology drawings.
- C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.
- D. Peralta Community College District Datacom Infrastructure Standards

1.03 REFERENCES

- A. Abbreviations and Acronyms:
1. OWNER: Merritt College
 2. BICSI: Building Industry Consulting Service International
 3. EIA: Electronics Industry Alliance
 4. ELFEXT Equal Level far End Cross Talk
 5. FTP Foiled Twisted Pair
 6. IDF: Intermediate Distribution Facility
 7. ILEC/LEC: Incumbent Local Exchange Carrier
 8. ISP: Inside Plant
 9. IT: Information Technology
 10. MDF: Main Distribution Frame
 11. MPOE: Minimum Point of Entry
 12. NEXT Near End Cross Talk
 13. OSP: Outside Plant
 14. PSELFEXT: Power Sum Equal Level far End Cross Talk
 15. PSNEXT: Power Sum Near End Cross Talk
 16. RCDD: Registered Communications Distribution Designer
 17. SCCS: Structured Communication Cable System
 18. TBD: To Be Determined
 19. TCIM: Telecommunication Cabling Installation Manual

- 20. TDMM: Telecommunications Distribution Methods Manual
- 21. TIA: Telecommunications Industry Association
- 22. UTP: Unshielded Twisted Pair
- 23. WAP: Wireless Access Point.

1.04 APPLICABLE REGULATORY REFERENCES

A. Contractor is responsible for knowledge and application of current versions of all applicable Standards and Codes. In cases where listed Standards and Codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.

- 1. ANSI/TIA:
 - a. TIA-526-7 (OFSTP-7) (2008) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - b. TIA-526-14-B (2010) (OFSTP-14) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - c. ANSI/TIOWNERIA-598-C (January 2005) Optical Fiber Cable Color Coding
 - d. ANSI/TIA-568-C.0 (September 2010) Generic Telecommunications Cabling for Customer Premises
 - e. TIA-568-C.0-1 (September 2010) Generic Telecommunications Cabling for Customer Premises-Addendum 1, Updated Reference for Balanced Twisted-Pair Cabling
 - f. ANSI/TIA-568-C.1 (February 2009) Commercial Building Telecommunications Cabling Standards
 - g. TIA-568-C.1-2 (November 2011) Commercial Building Telecommunications Cabling Standard, Addendum 2 General Updates
 - h. ANSI/TIA-568-C.2 (August 2009) Balance Twisted Pair Communications and Components Standards
 - i. ANSI/TIA-568-C.3 (June 2008) Optical Fiber Cabling Components Standard
 - j. ANSI/TIA-568-C.3-1 (December 2011) Optical Fiber Cabling Component Standard-Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors
 - k. ANSI/TIA-1183 (August 2012) Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
 - l. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard
 - m. ANSI/TIA-942-A (August 2012) Telecommunications Infrastructure Standard for Data Centers
 - n. ANSI/TIA-942-A-1 (March 2013) Telecommunications Infrastructure Standard for Data Centers, Addendum 1 - Cabling Guidelines for Data Center Fabrics
 - o. TIA-569-C (May 2012) Telecommunications Pathways and Spaces
 - p. TIA-569-C-1 (February 2013) Telecommunications Pathways and Spaces Addendum 1- Revised Temperature and Humidity Requirements for Telecommunications Spaces
 - q. ANSI/TIA-606-B (June 2012) Administration Standard for Telecommunications Infrastructure
 - r. TIA-607-B (September 2011) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
 - s. TIA-607-B-1 (January 2013) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises - External Grounding Addendum
 - t. TIA-758-B (April 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 - u. ANSI/TIA-598-C-2005, Optical Fiber Cable Color-coding
 - v. TIA-1152 (September 2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - w. ANSI/TIA-862-A (April 2011) Building Automation Systems Cabling Standard
 - x. TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard

- y. TIA-1005-A (June 2012) Industrial Telecommunications Infrastructure Standard for Manufacturing, Process & Refining
 - z. ANSI/TIA-1005 (March 2009) Telecommunications Infrastructure Standard for Industrial Premises
 - aa. TIA-1005-1 (March 2010) Telecommunications Infrastructure Standard for Industrial Premises; Addendum 1 - Industrial Pathways and Spaces
 - bb. TIA-1179 (July 2010) Healthcare Facility Telecommunications Infrastructure Standard.
2. ISO/IEC
 - a. ISO 11801 - Generic Cabling for Customer Premises
 - b. ISO/IEC TR 14763-2-1:2011 - Information technology -- Implementation and operation of customer premises cabling -- Part 2-1: Planning and installation - Identifiers within administration system.
 3. National Electric Codes
 - a. National Electrical Safety Code (NESC) (IEEE C2-2012)
 - b. ANSI/NFPA 70-2011, National Electrical Code® (NEC®)
 - c. ANSI/IEEE C2-207, National Electrical Safety Code®
 - d. National Electrical Code (NEC) (NFPA 70)
 4. OSHA Standards and Regulations – all applicable
 5. Local Codes and Standards – all applicable
 6. BICSI
 - a. Telecommunications Distribution Methods Manual, 13th Edition
 - b. BICSI 004-2012, Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
 - c. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 - d. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - e. Network Systems and Commissioning (NSC) reference, 1st Edition
 - f. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 - g. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - h. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 - i. AV Design Reference Manual, 1st Edition
 - j. Network Design Reference Manual, 7th Edition
 - k. Outside Plant Design Reference Manual, 5th Edition
 - l. Wireless Design Reference Manual, 3rd Edition
 - m. Electronic Safety and Security Design Reference Manual, 3rd Edition.
 7. Anywhere cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
 8. Knowledge and execution of applicable codes is the sole responsibility of the Contractor.
 9. Any code violations committed at the time of installation shall be remedied at the Contractor's expense.

1.05 SCOPE OF WORK

A. General project information:

1. These Specifications and associated drawings are the governing document for the installation of the telecommunications infrastructure and includes project descriptions, specified and recommended products, installation and project management methods, the scope of work and elevation drawing specifications.
2. This new, two-story Childcare Center and Lab located at Merritt College, Oakland, CA. The facility will include a child care center, teaching classrooms, offices and other support spaces.
3. Comply with Peralta Community College District Datacom Infrastructure Standards

4. Cabling contractor shall provide install:
 - a. all network cables required for IT and Security systems.
5. Owner furnished, and Contractor installed:
 - a. Wireless Access Points
6. Install required miscellaneous support system for all new horizontal cabling.
7. Provide patch cables for both the Telecommunications Room (TR) and work areas. Patch cable installation will be part of this scope of work.
8. Provide outlet types per plans.

B. Purpose:

1. This specification defines quality standards and practices common to all network cabling upgrades and projects. In addition, individual projects will have Requests for Proposals (RFP), associated drawings and requirements pertaining to their specific environments. Such collateral will be referred to in this document as "Project Specific Documentation" or simply "Construction Documents".
2. Voice and Data Networks encompass a broad spectrum of technologies used within the campus. Installed cables will be used for Ethernet, high and low speed data applications, used in analog and digital voice, not to exclude other existing and future Voice/Data technologies. This specification will include indoor cable installations, horizontal and backbone cabling, telecommunications closet and equipment cabling, equipment hardware as well as routing and support infrastructure.
3. It is the responsibility of the installing contractor to evaluate these general recommendations and adapt them effectively to actual projects. Contractor is responsible for identifying and bringing to the attention of any design directions that may be in conflict or otherwise improved. All such conflict resolutions shall be in writing from contractor to OWNER.
4. Note that while many portions of this global specification are addressed to "The Contractor", these requirements apply equally to anyone doing the network cabling and infrastructure work within, whether those persons are outside contractors or persons directly employed by the OWNER.
5. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other associated processes and physical apparatus necessary to turn-over the completed system fully warranted and operational for acceptance by OWNER and engineers.
6. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:
 - a. Cabling Sub-system – Horizontal
 - 1) Category UTP and STP cable
 - 2) Work area (equipment outlet) appliances and configuration
 - 3) Horizontal Pathways
 - 4) Copper Patching
 - b. Fiber Backbone Cabling
 - 1) Intrabuilding backbone
 - 2) Between telecom rooms
 - 3) Fiber Patching
 - c. Telecommunications Space
 - 1) Telecommunications Room Requirement
 - 2) Racks and Cabinets
 - 3) Overhead Pathways
 - 4) Rack mount UPSs and PDUs
 - d. Communications Grounding Systems
 - e. Communications Labeling and Administration

C. Scheduling:

1. Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work. All such documents shall be available through the General Contractor or Construction Manager.

1.06 CONTRACTOR QUALIFICATIONS

A. General:

1. Contractor shall have at least 5 years of experience installing and testing structured cabling systems.
2. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD), and the RCDD shall sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
3. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
4. Contractor shall be a current Panduit (or Berk-Tek/Leviton) Certified Installer certificate. A copy of corporate certificate must be included with quote.
5. Contractor shall have service facilities within 50 miles of project location.
6. At least 75 percent of the technicians on the job must have a current Panduit (or Berk-Tek/Leviton) Certified Copper Technicians certificate to install Panduit (or Berk-Tek/Leviton) Copper Distribution Systems.
7. At least 75 percent of the technicians installing any Fiber Distribution Systems must have a current Panduit (or Berk-Tek/Leviton) Certified Fiber Technicians certificate to install Fiber Distribution Systems.
8. Cabling contractor shall have active contractor's license, either C7 or C10 level, in the state of California.
9. The Telecommunications contractor must provide a project manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:
 - a. Initiate and coordinate tasks with the Project Manager and others as specified by the project schedule.
 - b. Provide day to day direction and on-site supervision of Contractor personnel.
 - c. Ensure conformance with all contract and warranty provisions.
 - d. Participate in weekly site project meetings.
 - e. This individual will remain project manager for the duration of the project. The contractor may change Project Manager only with the written approval of OWNER.

B. References:

1. Communications Contractor shall provide with bid a list of three reference accounts where similar Data, Voice, Fiber Optic Cable, and related equipment installation work was performed within the last year or twelve month period.

C. Insurance Requirements:

1. Contractor must be insured and shall provide with bid a Certificate of Indemnification, Certificate of Insurance, and meet all required insurance and licensing policies as specified by OWNER and any Federal, State, and local organization pertaining to data, voice and fiber optic cable installation.
2. Contractor's vehicles brought onto project properties, shall comply with all requirements of all Federal, State, and local agencies. Vehicles shall meet current DOT, state and local, safety inspections where required.

D. Termination of Services:

1. OWNER reserves the right to terminate the Communication Contractor's services if at any time the OWNER determines the Communication Contractor is not fulfilling their responsibilities as defined within this document.
2. Contractor's appearance and work ethics shall be of a professional manner, dress shall be commensurate with work being performed.

3. Dress displaying lewd or controversial innuendos will strictly be prohibited.
4. Conduct on project property will be professional in nature.
5. Any person in the Contractor's employ working on a project considered by to be incompetent or disorderly, or for any other reason unsatisfactory or undesirable, such person shall be removed from work on the project.
6. The Communications Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.

E. Other Contractor Responsibilities

1. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job. All work areas will be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.
2. Contractor must remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. This is mandatory; Contractors must consider this when placing bids.
3. Contractor shall abide by the regulations set by OWNER or OWNER Security Department pertaining to access to and conduct while on project property and shall obey speed limits and parking regulations.

1.07 SYSTEM PERFORMANCE WARRANTY

A. General

1. The horizontal communications cabling system installed shall be eligible for coverage by a Limited Lifetime Warranty to the end user.
 - a. Horizontal channels shall be completed with Leviton Network Solutions factory-terminated copper and/or fiber optic patch cords in order to be eligible for the applicable Berk-Tek or Leviton Warranty with channel performance guarantees.
 - b. Approved product shall be listed on the most recent version of the applicable Berk-Tek Leviton Technologies data sheets for each Berk-Tek Leviton Technologies solution.
2. Optimized Installer/Optimized Integrator shall provide labor, materials, and documentation in accordance with Berk-Tek and Leviton Network Solutions requirements necessary to ensure that the Owner will be furnished with a Limited Lifetime Warranty.
3. The installed structured cabling system shall provide a warranty guaranteeing installed channel performance above the ANSI/TIA 568-C requirements for Cat 6A cabling systems or ISO 11801 requirements for Cass D, Class E, and/or Class Ea.
 - a. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Berk-Tek Leviton Technologies approved certification tester in the appropriate channel or permanent link test configuration.
4. Necessary documentation for warranty registration shall be provided to the Panduit (or Berk-Tek/Leviton) by the installer (within 10 days) following 100 percent testing of cables.
 - a. Submit test results to Leviton Network Solutions or to Berk-Tek, in the certification tester's original software files.
 - b. Installer shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.
 - c. Optimized Contractor/Optimized Integrator must adhere to the terms and conditions of the respective Panduit (or Berk-Tek/Leviton)'s warranty programs.
5. Installer shall ensure that the Owner receives the Panduit (or Berk-Tek/Leviton) issued project warranty certificate within 60 calendar days of warranty registration.
6. Contractor shall provide a Panduit (or Berk-Tek/Leviton) 20 year System Warranty on all copper and fiber permanent cabling links.
7. This is a system performance warranty guaranteeing for 20 years from acceptance that the installed system shall support all data link protocols for which that copper category or fiber OS designation is engineered to support according to IEEE and TIA standards.
8. The Panduit (or Berk-Tek/Leviton) System Warranty may be invoked only if the cabling channel links are comprised of Panduit (or Berk-Tek/Leviton) connectivity and approved

by the Panduit (or Berk-Tek/Leviton). Patch cords must be same Panduit (or Berk-Tek/Leviton) of cable.

9. Upon acceptance of Warranty, Panduit (or Berk-Tek/Leviton) will mail a notification letter to the installer and a notification letter and warranty certificate to OWNER.

B. Contractor Warranty Obligations

1. Installation firm must be a current Panduit (or Berk-Tek/Leviton) Certified Installer in good standing and shall include a copy of the company certification with the bid.
2. Contractor shall name a supervisor to serve on site as a liaison responsible to inspect and assure all terminations are compliant to factory methods taught in Panduit (or Berk-Tek/Leviton) Technician Certification Training and according to all Standards cited in the Regulatory References section of this document.
3. Contractor liaison shall have a current, up-to-date Panduit (or Berk-Tek/Leviton) Certified Technician certificate in both copper and fiber. Copies of the copper and fiber certificates of the Panduit (or Berk-Tek/Leviton) liaison shall be submitted with the bid.
4. Contractor agrees all components comprising active links shall be of the same copper Category or fiber OS designation as the system being installed. Contractor shall under no circumstances mix different Categories or OS classes of cable or termination devices (connectors) within the same link or system.
5. Contractor shall install all racking and support structures according to cited TIA Standards in such fashion as to maintain both Standards and Panduit (or Berk-Tek/Leviton) recommendations for uniform support and protection, segregation of different cable types, maintenance of maximum pulling tensions, minimum bend radius, approved termination methods as well as adhering to industry accepted practices of good workmanship.
6. Contractor is responsible for understanding and submitting to Panduit (or Berk-Tek/Leviton) all documents required prior to project start to apply for this warranty. These include but are not limited to the project information form and SCS warranty agreement.
7. Contractor is responsible for understanding and submitting to Panduit (or Berk-Tek/Leviton) all documents required at project end. These include completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested.
8. Test results shall be delivered in the tester native format (not Excel) and represent the full test report. Summaries shall not be accepted. Contact Panduit (or Berk-Tek/Leviton) for a current list of approved testers, test leads and latest operating systems.
9. The Communications Contractor will correct any problems and malfunctions that are warranty-related issues without additional charge for the entire warranty period. The warranty period shall commence following the acceptance of the project by OWNER and written confirmation of Warranty from Panduit (or Berk-Tek/Leviton).

1.08 SAFETY

1. All cabling work being performed on project property or under contract to Technology Department must comply with Rules for safe operations, any state or local safety regulations and meet the requirements of OSHA Safety and Health Standards. The contractor Project Manager will maintain a copy of Rules for Safe Operations for reference.
2. It is the responsibility of the Communications Contractor to immediately correct any unsafe working practices on the part of contractor personnel. Unsafe working environments or conditions created by contractor personnel will be reported immediately to the OWNER Project Manager.
3. Any liability for correction of conditions created by the contractor's personnel rests with the contractor.
4. The Communications Contractor shall be solely and completely responsible for conditions of the job site (as pertaining to the materials and equipment specified), including safety of persons and property during performance of work.
5. No act, service, drawing review or construction observance by any employee, representative or engineer may be construed as a review or approval of the adequacy of the Contractor(s) safety measures, in, on, or near the construction site.

1.09 WORKING CONDITIONS

- A. Site Access
 - 1. All cable installations must be pre-approved by the OWNER Project Manager to ensure that the necessary arrangements have been made for proper access to project sites.
 - 2. A twenty-four-hour prior notice shall be submitted to the OWNER Project Manager for any work schedule changes.
 - 3. Communications Contractor shall display badges or passes as mandated by project property Security Department Rules and Regulations.

- B. Scheduling
 - 1. Coordination of site surveys and the issue of project OWNER owned materials and equipment will be the responsibility of the OWNER Project Manager. Once said equipment and materials are in the Contractor's possession, it is the Contractor's to safeguard the material and equipment from damage or theft.
 - 2. Information required by the Contractor to price and complete a defined scope of work will be furnished to the Communications Contractor by the OWNER Project Manager in a Scope of Work document and at the time of the site survey (if necessary) and will be maintained by the Communications Contractor until the completion of the job.
 - 3. It is the Contractor's responsibility to begin work promptly according to the Start Dates and to complete work by the Proposed Completion Date listed on the Cable Run Request Form.
 - 4. The Contractor must notify the OWNER Project Manager in writing of any delays; at that time they shall come up with a mutually agreeable project schedule.
 - 5. The Communications Contractor will coordinate with the OWNER Project Manager working hours and job site access issues.
 - 6. The Communications Contractor will coordinate with the OWNER Project Manager to minimize outages to the existing systems.
 - 7. Any service interruption required by the Communications Contractor must be requested in writing, and scheduled with the OWNER Project Manager.
 - 8. The Communications Contractor shall not proceed with the requested service interruption until written approval is granted by the OWNER Project Manager.
 - 9. All problems, and questions relating to a particular job, will be referred to the OWNER Project Manager and no changes shall be made without his/her written approval.

- C. Harmony Clause
 - 1. Contractor shall coordinate and work in harmony with other trades on the project as well as with OWNER personnel including architect and engineers.

1.10 COORDINATION

- A. Coordinate layout and installation of voice, data, and video communication cabling with other Merritt College contractors and equipment suppliers.
 - 1. Meet jointly with other contractors, equipment suppliers, and Merritt College (IT and Security) to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connect and patch panels in equipment rooms and telecommunications rooms to accommodate and optimize arrangement and space requirements of voice and LAN equipment.
 - 4. When indicated on drawings, contractor shall reuse existing copper and fiber optic backbone cables.
 - 5. Provide weekly progress reports and crew schedules to Campus representatives by 5:00 PM, Thursday of each project work week.

1.11 ACTION SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C. Product Data: For each product indicated.
 - 1. Submit all product data in accordance with general requirements of the construction documents.
 - 2. Submit product cut sheets and a detailed list of components a minimum of two (2) weeks prior to commencement of Division-27 work for OWNER and engineer review and action.
 - 3. Alternate and "Or Approved Equal" designated products must be submitted for review and judgment to the OWNER prior to installation. The contractor-proposed alternate products or components must be verified by two (2) independent sources within the past 6 months. This request shall include the two (2) independent sources, the original Product's specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product.
 - 4. Any request of an alternate or substitution must be submitted to the OWNER for action no later than fourteen (14) calendar days after release of the original telecommunications bid documents.

1.12 SCCS COMPONENTS

- A. The Contract Documents generally outline industry standard components to be installed as part of the Campus's SCCS (Structured installation requirements. Such identification is intended to be general in nature rather than exhaustive. All stated quantities are subject to validation by SCCS Contractor. SCCS Contractor is reminded that differences between estimated quantities and those reasonably derived based from the Contract Documents (as well as through bid conferences, job walks, addendums, and other distribution of information) shall be the responsibility of the SCCS Contractor. There shall be no additional cost incurred by Merritt College for complying with the specifications and requirements of the Contract Documents.
- B. Any variance from those components identified on the drawings and/or below shall be submitted to Merritt College/Campus representatives for approval prior to ordering and installation; the risk for all costs incurred by the SCCS Contractor for materials ordered prior to such written approval shall be borne entirely by the SCCS Contractor. Nonetheless, it is imperative that the SCCS Contractor determine the availability of necessary materials and propose equivalent substitutes as necessary to meet all installation milestones. Delays in SCCS installations due to lack of product availability are unacceptable. As catalog numbers change frequently, the SCCS Contractor must verify all part numbers prior to ordering materials. Clarifications will be issued in response to written Requests for Information (RFI).
- C. All UTP, STP , fiber optic cabling, innerduct and Velcro, where required, will be plenum-rated (i.e., CMP, ONFP). Copper and fiber optic backbone cable intended for installation within conduit, riser shafts and chases, etc., shall be at a minimum, rated CMR (riser rated). Unrated cable (such as filled ASP) shall not be installed within the structure except when placed within IMT, PVC or RGS conduit.
- D. Throughout this specification, Leviton/Berk-tek, General Cable, B-Line, Inc. and other Panduit (or Berk-Tek/Leviton)s are cited. These citations are for the purpose of establishing quality, performance and warranty certification criteria.

- E. Horizontal Distribution Subsystem: Intra-building twisted-pair and fiber optic communications cabling connecting Telecommunication Rooms (TRs) to Telecommunication Outlets (TOs) located at individual work areas.
- F. Horizontal Cabling: Combination of the following types of cables from TR to TO:
 - 1. Category 6A (100-Ohm, 4-pair, unshielded twisted pair) cables from TRs to TOs, or Category 6A shielded (100-Ohm, 4-pair, shielded twisted pair) cables from TRs to TOs.
- G. Communications Horizontal Cabling System: Includes cables, jacks, patch panels, connecting blocks, patch cords, fiber connectors, fiber adapter plates, fiber enclosures, jumpers, and all required necessary support systems, such as cable managers and faceplates.
- H. Cables: Route through conduit, cable trays, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile, and through plenum air-handling spaces above ceiling tile.
- I. Furnish and install all materials necessary for a complete and working communications horizontal cabling system.

1.13 DELIVERY AND STORAGE

- A. SCCS Contractor shall provide a materials schedule prior to the start date of cable installation. Material schedule shall specify all material quantities and their delivery date for this project.
- B. SCCS Contractor shall provide protection from weather, moisture, dirt, dust and other contaminants for telecommunications cabling and pathway equipment placed in storage.

1.14 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 - 1. Submit all shop drawings in accordance with the general requirements of the construction documents.
 - 2. Submit shop drawings a minimum of two (2) weeks PRIOR to commencement of Division-27 work for OWNER review and action.
 - 3. Shop drawings shall include evidence of grounding and bonding components are coordinated with field conditions and the work of other trades.
 - 4. This submittal may have a written component and a visual, drawn component for review and action by the OWNER prior to installation.
- B. Certificates:
 - 1. Submit management and installation team reference documentation verifying:
 - a. The project manager is a RCDD in good standing with BICSI and is qualified to manage the scope of work described in the contract documents and has five (5) years of experience managing similar projects in size and scope. The documentation shall include the RCDD registration number.
 - b. The field supervisor is a BICSI trained technician that is qualified to perform and oversee the work described in the contract documents.
 - c. Installer's Project References: Submit installer's list of successfully completed communications horizontal cabling projects, including project name and location, name of architect, and type and quantity of communications horizontal cabling installed.
- C. Qualification Statements:
 - 1. The contractor shall submit documentation that within the past 12 months, a minimum of 75% of all installation personnel have been trained or certified by the Panduit (or Berk-Tek/Leviton) of the products they are installing.

1.15 CLOSEOUT SUBMITTALS

- A. As-Built Drawings:
 1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
 2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for OWNER and OWNER reference.
 3. Communication contractor to print, frame and mount approved as-built drawings in MPOE. Coordinate location with OWNER.

1.16 QUALITY ASSURANCE

- A. Qualifications – Panduit (or Berk-Tek/Leviton)
 1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.
- B. Qualifications – Installer:
 1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the Panduit (or Berk-Tek/Leviton) of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.
 2. Approved Leviton Optimized Installer or Berk-Tek Oasis Optimized Integrator Optimized before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.
 3. Responsible for workmanship and installation practices in accordance with Leviton Optimized Installer Program and Berk-Tek Oasis Program.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.
- B. Notify Architect and design team of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.02 RE-INSTALLATION

- A. No additional burden to the OWNER regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the OWNER prior to beginning any re-installation work

3.03 INSTALLATION

- A. Install communications horizontal cabling in accordance with Panduit (or Berk-Tek/Leviton)'s instructions, ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, ANSI/TIA-569-C, BICSI TDMM, and NFPA 70.
- B. Copper Patch Cords and Fiber Jumpers: Manufactured by Leviton Network Solutions.
- C. Install cables after building interior has been physically protected from weather and mechanical work likely to damage cabling has been completed.

- D. Ensure cable pathways are completely and thoroughly cleaned before installing cabling.
- E. Inspect installed conduit, wireway, cable trays, and innerduct.
- F. Clean additional enclosed raceway and innerduct systems furnished.
- G. Provide protection for exposed cables where subject to damage.
- H. Abrasion Protection:
 - 1. Provide abrasion protection for cable or wire bundles which pass through holes or across edges of sheet metal.
 - 2. Use protective bushings to protect cables.
- I. Cable Ties and Other Cable Management Clamps:
 - 1. No more than hand tightened.
 - 2. Fit snugly, but not compress, crimp, or otherwise change physical characteristics of cable jacket or distort placement of twisted-pair components.
 - 3. Replace cables exhibiting stresses due to over tightening of cable management devices.
 - 4. Use plenum-rated cable ties in plenum spaces.
 - 5. Velcro wraps are preferred over cable ties for all cable bundles.
- J. Where possible, route cables in overhead cable trays and inside wire management systems attached to equipment cabinets and racks.
 - 1. Use Velcro, plastic ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
 - 2. Cable Trays: Do not exceed 40 percent fill.
- K. Pull Cord:
 - 1. Nylon, 1/8-inch minimum.
 - 2. Co-install with cables installed in conduit.
- L. Cable Raceways: Do not fill greater than ANSI/TIA-569-B maximum fill for particular raceway type.
- M. Support horizontal cables at a maximum of 48-inch irregular intervals, if J-hook or trapeze system is used to support cable bundles.
- N. Do not allow cables to rest on acoustic ceiling grids, plumbing pipes, or electrical conduits.
- O. Bundle horizontal distribution cables in groups of no more than amount of cables designed for by cable support Panduit (or Berk-Tek/Leviton), based on cable OD and weight.
- P. Fire-Sprinkler System:
 - 1. Install cables above fire-sprinkler system.
 - 2. Do not attach cables to fire-sprinkler system or ancillary equipment or hardware.
 - 3. Install cable system and support hardware so that it does not obscure valves, fire alarm conduit, boxes, or other control devices.
- Q. Do not attach cables to ceiling grid or lighting fixture wires.
- R. Install appropriate carriers to support cabling, where support for horizontal cables are required.
- S. Replace before final acceptance, cables damaged or exceeding recommended installation parameters during installation.

3.04 INSTALLATION – UNSHIELDED TWISTED-PAIR CABLES

- A. Install unshielded twisted-pair cables in accordance with Panduit (or Berk-Tek/Leviton)'s instructions.
- B. Install cables in continuous lengths from origin to destination, without splices, except for transition points or consolidation points.

- C. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure intended and suitable for the purpose.
- D. Cable Minimum Bend Radius and Maximum Pulling Tension:
 - 1. Do not exceed bend radius for UTP = 4 X Cable OD, FTP = 4 X Cable OD.
 - 2. Install unshielded twisted-pair cables so that there are no bends smaller than 4 times cable outside diameter at any point in the run and at the termination field.
 - 3. Pulling Tension on 4-Pair UTP Cables: Do not exceed 25 ft.lb. for 4-pair UTP cable.
- E. Separation from Power Lines: Provide following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:
 - 1. Open or Nonmetal Communications Pathways:
 - a. Electric motors, fluorescent light fixtures, and unshielded power lines carrying up to 3 kVA: 12 inches.
 - b. Electrical equipment and unshielded power lines carrying more than 5 kVA: 36 inches.
 - c. Large electrical motors or transformers: 48 inches.
 - 2. Grounded Metal Conduit Communications Pathways:
 - a. Electrical equipment and unshielded power lines carrying up to 2 kVA: 2-1/2 inches.
 - b. Electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA: 6 inches.
 - c. Electrical equipment and unshielded power lines carrying more than 5 kVA: 12 inches.
 - d. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA: 3 inches.
 - e. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying more than 5 kVA: 6 inches.

3.05 INSTALLATION – UNSHIELDED TWISTED-PAIR TERMINATION

- 1. Coil cables to house cable coil without exceeding Panduit (or Berk-Tek/Leviton)'s bend radius.
 - a. In hollow wall installations where box eliminators are used, store excess wire in wall.
 - b. Store no more than 12 inches of UTP and 36 inches of fiber slack.
 - c. Loosely coil excess slack and store in ceiling above each drop location, when there is not enough space present in outlet box to store slack cables.
- 2. Dress and terminate cables in accordance with ANSI/TIA-568-C.0, ANSI/TIA- C.1, BICSI TDMM, and Panduit (or Berk-Tek/Leviton)'s instructions.
- 3. Terminate 4-pair cables on jack and patch panels using T568-B or T568-A wiring scheme.
- 4. Pair Untwist at Termination: Do not exceed 12 mm (1/2 inch).
- 5. Bend Radius of Horizontal Cables:
 - a. Not less than 4 times OD of UTP cables.
 - b. Not less than 4 times OD of FTP cables.
- F. Maintain cable jacket to within 25 mm (1 inch) of termination point.
- G. Neatly bundle cables and dress to their respective panels or blocks.
 - 1. Feed each panel or block by individual bundle separated and dressed back to point of cable entrance into rack or frame

3.06 INSTALLATION – OPTICAL FIBER CABLES

- 1. Place fiber optic cables to maintain minimum cable bend radius limits specified by Panduit (or Berk-Tek/Leviton) or 15 times cable diameter, whichever is larger.
- 2. Use care when handling fiber optic cables.
- 3. Carefully monitor pulling tension so as not to exceed limits specified by Panduit (or Berk-Tek/Leviton).
- 4. Do not splice horizontal fiber optic cables.

3.07 CLOSEOUT ACTIVITIES

- A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the OWNER and OWNER team.
- B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the OWNER

END OF SECTION

SECTION 27 0500
COMMON WORKS FOR COMMUNICATION

PART 1 - GENERAL**1.01 SUMMARY**

- A. Section Includes:
1. Sleeves for pathways and cables.
 2. Sleeve seals.
 3. Grout.
 4. Common communications installation requirements.

1.02 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS**2.01 SLEEVES FOR PATHWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch .
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or Equal
 3. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 4. Pressure Plates: Stainless steel. Include two for each sealing element.
 5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.03 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.04 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 27 0526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Comply with Peralta Community College District Datacom Infrastructure Standards

1.02 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.03 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For each conductor and cable indicating lead content.
- C. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.
 - 2. Ground and roof rings.
 - 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- C. Qualification Data: For Installer, installation supervisor, and field inspector.
- D. Qualification Data: For testing agency and testing agency's field supervisor.
- E. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-B.

2.02 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line.
 - 2. Panduit Corp.
 - 3. Approved Equal.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
 - 3. Lead Content: Less than 300 parts per million.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
 - 2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-Line.
 2. Chatsworth Products, Inc.
 3. Panduit Corp.
 4. Approved Equal.
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.04 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-Line.
 2. Chatsworth Products, Inc.
 3. Panduit Corp.
 4. Approved Equal.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
 1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.

3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
 1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.05 GROUND RODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-Line.
 2. Chatworth.
 3. Panduit.
 4. Approved Equal.
- B. Ground Rods: [Copper-clad] [Zinc-coated] [Stainless-] steel[, sectional type]; 3/4 inch by 10 feet 5/8 by 96 inches in diameter.

2.06 IDENTIFICATION

- A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

3.03 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.04 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

3.05 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.06 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install **[top-mounted] [vertically mounted]** rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.
- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using **[No. 6] <Insert number>** AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- M. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.

4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.07 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.08 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room

- containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
- a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
- a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

**SECTION 27 0529
HANGERS AND SUPPORTS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 1. Provides specifications for non-continuous cable support components utilized to provide pathways support to telecommunications cables traveling outside cable trays, conduits, or other continuous cable supports.
 2. Non-continuous cable supports.

1.02 RELATED DOCUMENTS

- A. All divisions of the specification and general provisions of the Construction Documents. Architectural, mechanical, electrical, and all technology drawings. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.
- B. Peralta Community College District Datacom Infrastructure Standards

1.03 REFERENCES

- A. Abbreviations and Acronyms:
 1. A/E: Architect / Engineer (designer)
 2. AHJ: Authority Having Jurisdiction
 3. BICSI: Building Industry Consulting Service International
 4. EIA: Electronics Industry Alliance
 5. TDMM: Telecommunications Distribution Methods Manual
 6. TIA: Telecommunications Industry Association
 7. UL: Underwriters Laboratory

1.04 APPLICABLE REGULATORY REFERENCES

- A. Contractor is responsible for knowledge and application of current versions of all applicable Standards and Codes. In cases where listed Standards and Codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
 1. ANSI/TIA:
 - a. TIA-526-7 (OFSTP-7) (2008) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - b. TIA-526-14-B (2010) (OFSTP-14) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - c. ANSI/TIA/EIA-598-C (January 2005) Optical Fiber Cable Color Coding
 - d. ANSI/TIA-568-C.0 (September 2010) Generic Telecommunications Cabling for Customer Premises
 - e. TIA-568-C.0-1 (September 2010) Generic Telecommunications Cabling for Customer Premises-Addendum 1, Updated Reference for Balanced Twisted-Pair Cabling
 - f. ANSI/TIA-568-C.1 (February 2009) Commercial Building Telecommunications Cabling Standards
 - g. TIA-568-C.1-2 (November 2011) Commercial Building Telecommunications Cabling Standard, Addendum 2 General Updates
 - h. ANSI/TIA-568-C.2 (August 2009) Balance Twisted Pair Communications and Components Standards
 - i. ANSI/TIA-568-C.3 (June 2008) Optical Fiber Cabling Components Standard

- j. ANSI/TIA-568-C.3-1 (December 2011) Optical Fiber Cabling Component Standard-Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors
- k. ANSI/TIA-1183 (August 2012) Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
- l. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard
- m. ANSI/TIA-942-A (August 2012) Telecommunications Infrastructure Standard for Data Centers
- n. ANSI/TIA-942-A-1 (March 2013) Telecommunications Infrastructure Standard for Data Centers, Addendum 1 - Cabling Guidelines for Data Center Fabrics
- o. TIA-569-C (May 2012) Telecommunications Pathways and Spaces
- p. TIA-569-C-1 (February 2013) Telecommunications Pathways and Spaces Addendum 1- Revised Temperature and Humidity Requirements for Telecommunications Spaces
- q. ANSI/TIA-606-B (June 2012) Administration Standard for Telecommunications Infrastructure
- r. TIA-607-B (September 2011) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
- s. TIA-607-B-1 (January 2013) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises - External Grounding Addendum
- t. TIA-758-B (April 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
- u. ANSI/TIA-598-C-2005, Optical Fiber Cable Color-coding
- v. TIA-1152 (September 2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- w. ANSI/TIA-862-A (April 2011) Building Automation Systems Cabling Standard
- x. TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
- y. TIA-1005-A (June 2012) Industrial Telecommunications Infrastructure Standard for Manufacturing, Process & Refining
- z. ANSI/TIA-1005 (March 2009) Telecommunications Infrastructure Standard for Industrial Premises
- aa. TIA-1005-1 (March 2010) Telecommunications Infrastructure Standard for Industrial Premises; Addendum 1 - Industrial Pathways and Spaces
- bb. TIA-1179 (July 2010) Healthcare Facility Telecommunications Infrastructure Standard.
- 2. ISO/IEC
 - a. ISO 11801 - Generic Cabling for Customer Premises
 - b. ISO/IEC TR 14763-2-1:2011 - Information technology -- Implementation and operation of customer premises cabling -- Part 2-1: Planning and installation - Identifiers within administration system.
- 3. National Electric Codes
 - a. National Electrical Safety Code (NESC) (IEEE C2-2012)
 - b. ANSI/NFPA 70-2011, National Electrical Code® (NEC®)
 - c. ANSI/IEEE C2-207, National Electrical Safety Code®
 - d. National Electrical Code (NEC) (NFPA 70)
- 4. OSHA Standards and Regulations – all applicable
- 5. Local Codes and Standards – all applicable
- 6. BICSI
 - a. Telecommunications Distribution Methods Manual, 13th Edition
 - b. BICSI 004-2012, Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
 - c. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 - d. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - e. Network Systems and Commissioning (NSC) reference, 1st Edition
 - f. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 - g. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

- h. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 - i. AV Design Reference Manual, 1st Edition
 - j. Network Design Reference Manual, 7th Edition
 - k. Outside Plant Design Reference Manual, 5th Edition
 - l. Wireless Design Reference Manual, 3rd Edition
 - m. Electronic Safety and Security Design Reference Manual, 3rd Edition.
7. Anywhere cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
 8. Knowledge and execution of applicable codes is the sole responsibility of the Contractor.
 9. Any code violations committed at the time of installation shall be remedied at the Contractor's expense.

1.05 AMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Install and coordinate the telecommunications cabling work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interference in a manner accepted by the architect. Any repairs or changes made necessary in the contract work, caused by the contractor's neglect, shall be made by the contractor at their own expense.
- B. Scheduling:
 2. Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work. All such documents shall be available through the General Contractor or Construction Manager.

1.06 ACTION SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C, Product Data: For each product indicated.
 1. Submit all product data in accordance with general requirements of the construction documents.
 2. Submit product cut sheets and a detailed list of components a minimum of two (2) weeks prior to commencement of Division-27 work for A/E review and action.
 3. Alternate and "Or Approved Equal" designated products must be submitted for review and judgment to the A/E prior to installation. The contractor-proposed alternate products or components must be verified by two (2) independent sources within the past 6 months. This request shall include the two (2) independent sources, the original Product's specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product.
 4. Any request of an alternate or substitution must be submitted to the A/E for action no later than fourteen (14) calendar days after release of the original telecommunications bid documents.

1.07 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 1. Submit all shop drawings in accordance with the general requirements of the construction documents.
 2. Submit shop drawings a minimum of two (2) weeks prior to commencement of Division-27 work for A/E review and action.
 3. Shop drawings shall include evidence of grounding and bonding components are coordinated with field conditions and the work of other trades.

4. This submittal may have a written component and a visual, drawn component for review and action by the A/E prior to installation.
- B. Certificates:
1. Submit management and installation team reference documentation verifying:
 - a. The project manager is a RCDD in good standing with BICSI and is qualified to manage the scope of work described in the contract documents and has five (5) years of experience managing similar projects in size and scope. The documentation shall include the RCDD registration number.
 - b. The field supervisor is a BICSI trained technician that is qualified to perform and oversee the work described in the contract documents

1.08 CLOSEOUT SUBMITTALS

As-Built Drawings:

1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Owner reference:

1.09 QUALITY ASSURANCE

A. Qualifications – Manufacturer

1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

PART 2 - PRODUCTS

2.01 NON-CONTINUOUS CABLE SUPPORTS

A. Basis-of-Design Product: Subject to compliance with requirements:

1. Copper B-Line
2. Chatsworth
3. Or Approved Equal

B. Product Options:

1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirement.

C. Description:

1. Non-continuous cable supports shall be available in multiple sizes, styles and materials. Rigid supports shall be equipped with flared edges and pre-configured bend radius controls.
2. Provide drop wire supports and threaded rod assemblies in areas where structural mounting surfaces are non-functional or inaccessible.
3. Sling assemblies shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance UTP and optical fiber cables. Support slings shall have a static load limit of 100 lbs.
4. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be reusable.
5. Select approved non-continuous cable supports suitable for specific installation environments and/or air handling (plenum) spaces.

D. J-hooks or Cable Slings:

1. J-hooks or Cable slings shall be used in locations where the communication cable (bundles of 50 or more cables) is not supported by continuous systems such as cable trays or conduit.

E. Support Requirements

1. Provide cable slings every 48-60" at a maximum, attached to threaded rod or ceiling hangers to provide support for cable bundles or innerduct.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

3.02 INSTALLATION

- A. Process:
 1. Follow manufacturer's instructions and recommended industry standards and guidelines.
 2. The installed non-continuous support system must be an independent support structure for the voice/data communication system.
 3. Draping cables over other structures in the ceiling is unacceptable. Water pipes, ceiling grid, sprinkler system, electrical supports, air ducts or any other in-ceiling structure may not be used for cable support.
 4. Contractor installed supports shall be used to supplement the main cable support system when any cabling leaves the main support system or is unsupported for more than three and one half feet (3'-5'-0") feet.
 5. Non-continuous supports shall be installed with ceiling wire or threaded rod secured to the slab above to support the telecommunications cable infrastructure parallel to the slab throughout the cable plant, unless site conditions dictate a non-parallel installation.
 6. Cable must be routed to follow existing corridors and parallel or 90 degree angles from all walls and the cable tray whenever possible.

3.03 RE-INSTALLATION

- A. No additional burden to the owner regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re- installation work shall be coordinated, in writing, with the owner prior to beginning any re- installation work

3.04 CLOSEOUT ACTIVITIES

- A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Owner and A/E team.

Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Owner

END OF SECTION

SECTION 27 0533
CONDUIT AND FLOOR BOXES COMMUNICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Provides specifications for conduit pathways, back boxes and pull box enclosures utilized for the distribution and housing of telecommunications cabling and components:
 2. Telecom EMT conduit and boxes

1.02 RELATED DOCUMENTS

- A. All divisions of the specification and general provisions of the Construction Documents.
- B. Architectural, mechanical, electrical, and all technology drawings.
- C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 REFERENCES

- A. Abbreviations and Acronyms:
1. A/E: Architect / Engineer (designer)
 2. ANSI: American National Standards Institute
 2. AHJ: Authority Having Jurisdiction
 3. BICSI: Building Industry Consulting Service International
 4. EIA: Electronics Industry Alliance
 5. TDMM: Telecommunications Distribution Methods Manual
 6. TIA: Telecommunications Industry Association
 7. UL: Underwriters Laboratory
- B. Codes and Regulations: (Note: Reference Division One for specific code versions governing the work in addition to the information noted below.)
1. National Electric Safety Code (NESC) – 2012
 2. National Fire Protection Association (NFPA)
 3. 2013 California Electrical Code
 4. 2013 California Building Code
 5. Local Municipal Codes

1.04 APPLICABLE REGULATORY REFERENCES

- A. Contractor is responsible for knowledge and application of current versions of all applicable Standards and Codes. In cases where listed Standards and Codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
1. ANSI/TIA:
 - a. TIA-526-7 (OFSTP-7) (2008) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - b. TIA-526-14-B (2010) (OFSTP-14) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - c. ANSI/TIA/EIA-598-C (January 2005) Optical Fiber Cable Color Coding
 - d. ANSI/TIA-568-C.0 (September 2010) Generic Telecommunications Cabling for Customer Premises
 - e. TIA-568-C.0-1 (September 2010) Generic Telecommunications Cabling for Customer Premises-Addendum 1, Updated Reference for Balanced Twisted-Pair Cabling

- f. ANSI/TIA-568-C.1 (February 2009) Commercial Building Telecommunications Cabling Standards
 - g. TIA-568-C.1-2 (November 2011) Commercial Building Telecommunications Cabling Standard, Addendum 2 General Updates
 - h. ANSI/TIA-568-C.2 (August 2009) Balance Twisted Pair Communications and Components Standards
 - i. ANSI/TIA-568-C.3 (June 2008) Optical Fiber Cabling Components Standard
 - j. ANSI/TIA-568-C.3-1 (December 2011) Optical Fiber Cabling Component Standard-Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors
 - k. ANSI/TIA-1183 (August 2012) Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
 - l. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard
 - m. ANSI/TIA-942-A (August 2012) Telecommunications Infrastructure Standard for Data Centers
 - n. ANSI/TIA-942-A-1 (March 2013) Telecommunications Infrastructure Standard for Data Centers, Addendum 1 - Cabling Guidelines for Data Center Fabrics
 - o. TIA-569-C (May 2012) Telecommunications Pathways and Spaces
 - p. TIA-569-C-1 (February 2013) Telecommunications Pathways and Spaces Addendum 1- Revised Temperature and Humidity Requirements for Telecommunications Spaces
 - q. ANSI/TIA-606-B (June 2012) Administration Standard for Telecommunications Infrastructure
 - r. TIA-607-B (September 2011) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
 - s. TIA-607-B-1 (January 2013) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises - External Grounding Addendum
 - t. TIA-758-B (April 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 - u. ANSI/TIA-598-C-2005, Optical Fiber Cable Color-coding
 - v. TIA-1152 (September 2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - w. ANSI/TIA-862-A (April 2011) Building Automation Systems Cabling Standard
 - x. TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
 - y. TIA-1005-A (June 2012) Industrial Telecommunications Infrastructure Standard for Manufacturing, Process & Refining
 - z. ANSI/TIA-1005 (March 2009) Telecommunications Infrastructure Standard for Industrial Premises
 - aa. TIA-1005-1 (March 2010) Telecommunications Infrastructure Standard for Industrial Premises; Addendum 1 - Industrial Pathways and Spaces
 - bb. TIA-1179 (July 2010) Healthcare Facility Telecommunications Infrastructure Standard.
2. ISO/IEC
 - a. ISO 11801 - Generic Cabling for Customer Premises
 - b. ISO/IEC TR 14763-2-1:2011 - Information technology -- Implementation and operation of customer premises cabling -- Part 2-1: Planning and installation - Identifiers within administration system.
 3. National Electric Codes
 - a. National Electrical Safety Code (NESC) (IEEE C2-2012)
 - b. ANSI/NFPA 70-2011, National Electrical Code© (NEC©)
 - c. ANSI/IEEE C2-207, National Electrical Safety Code®
 - d. National Electrical Code (NEC) (NFPA 70)
 4. OSHA Standards and Regulations – all applicable
 5. Local Codes and Standards – all applicable
 6. BICSI
 - a. Telecommunications Distribution Methods Manual, 13th Edition
 - b. BICSI 004-2012, Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities

- c. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 - d. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - e. Network Systems and Commissioning (NSC) reference, 1st Edition
 - f. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 - g. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - h. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 - i. AV Design Reference Manual, 1st Edition
 - j. Network Design Reference Manual, 7th Edition
 - k. Outside Plant Design Reference Manual, 5th Edition
 - l. Wireless Design Reference Manual, 3rd Edition
 - m. Electronic Safety and Security Design Reference Manual, 3rd Edition.
7. Anywhere cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
 8. Knowledge and execution of applicable codes is the sole responsibility of the Contractor.
 9. Any code violations committed at the time of installation shall be remedied at the Contractor's expense.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Install and coordinate the telecommunications cabling work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interference in a manner accepted by the architect. Any repairs or changes made necessary in the contract work, caused by the contractor's neglect, shall be made by the contractor at their own expense.
- B. Scheduling:
 1. Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work. All such documents shall be available through the General Contractor or Construction Manager.

1.06 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
 1. Submit all product data in accordance with general requirements of the construction documents.
 2. Submit product cut sheets and a detailed list of components a minimum of six (2) weeks prior to commencement of Division-27 work for A/E review and action.
 3. Alternate and "Or Equal" designated products must be submitted for review and judgment to the A/E prior to installation. The contractor-proposed alternate products or components must be verified by two (2) independent sources within the past 6 months. This request shall include the two (2) independent sources, the original Product's specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product.
 4. Any request of an alternate or substitution must be submitted to the A/E for action no later than fourteen (14) calendar days after release of the original telecommunications bid documents.

1.07 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 1. Submit all shop drawings in accordance with the general requirements of the construction documents.
 2. Submit shop drawings a minimum of six (2) weeks prior to commencement of Division-27 work for A/E review and action.
 3. Shop drawings shall include evidence of grounding and bonding components are coordinated with field conditions and the work of other trades.

4. This submittal may have a written component and a visual, drawn component for review and action by the A/E prior to installation.

1.08 CLOSEOUT SUBMITTALS



- A. As-Built Drawings:
 1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
 2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Owner reference:

PART 2 - PRODUCTS

2.01 CONDUIT AND BACKBOXES

- A. Conduits serving individual work area outlets shall be a minimum of 1 in. Individual work area outlet conduits are to be dedicated to only one outlet box each and shall not be “daisy-chained” together.
- B. Conduits for backbone cabling in the building riser and incoming services shall be a minimum of three 4in.
- C. Electrical Metallic Tubing (EMT) conduit
 1. EMT shall be used for installations within the confines of an environmentally controlled building.
 2. EMT conduit is not acceptable for non-rated cable installations.
 3. EMT conduit may be used as sleeves for wall penetrations, and for floor core riser penetrations.
 4. EMT conduit connectors and fittings shall be installed using “Set-Screw” type or air-tight “Compression” type fittings.
- D. Flexible Conduit (“Flex”)
 1. Flexible conduit shall not be used for communication cable installation when EMT conduit is available.
 2. Flex conduit may used for connections into modular furniture or similar applications.
 3. When using Flex conduit, increase the diameter of the Flex by one trade size over what the requirement would be using smooth-wall conduit.
 4. Flexible conduit runs may not exceed 5 feet.
- E. Plastic Conduit/Polyvinyl Chloride (PVC) conduit
 1. Plastic and PVC conduit shall be used for underground duct construction between buildings and vaults.
 2. PVC conduit shall not be used within buildings per NEC Code and UBC (Uniform Building Code).
 3. The PVC conduit shall be Schedule 40 PVC. Plastic.
 - a. JM Eagle
 - b. Electro Flex
 - c. Or equal
- F. Pull boxes
 1. Hoffman Engineering Co,
 2. Or equal.
- G. Back Boxes
 1. Wiremold/Legrand
 2. Thomas & Betts,
 3. Hubbell Raco,
 4. RANDL Industries
 5. Or approved equal

H. Multi-service floor boxes and poke-thru, contractor shall provide and install

SYMBOL	FLOORBOX RECOMMENDATION (GROUND FLOOR)	POKE-THRU RECOMMENDATION (2ND)
	RFB6-OG	EVOLUTION 6AT
	EFB8S-OG	EVOLUTION 8AT

2.02 TELECOMMUNICATIONS CONDUIT AND BACKBOXES

- A. Electrical Metallic Galvanized Tubing and Fittings with natural finish for all conduits not exposed: ANSI C80.3 with compression-type fittings.
- B. Indoor Pull boxes: Galvanized steel, screw cover pull box. Grey polyester powder coat finish inside and out. NEMA Type 1. Pull boxes to be sized per NEC code to accommodate the number of EMT conduits as shown on Telecom drawings with adequate clearances, access and cable management space.
- C. Supporting devices: U channel trapeze assemblies, 1/2" Threaded rods, clamps, conduit straps, C-clamps and retainers.
- D. Fasteners: 3/4" Carbon steel expansion anchors with 2 1/2" embed into concrete slab for pull box U-channel support attachment to concrete slab. The anchors must be tested and approved under dual load conditions: Hilti Kwikbolt 3, Ramset/Redhead Trubolt. Or equal.
- E. U-channel systems: 16 gauge steel channels. Provide fittings and accessories that match with the U-channel of the same manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

3.02 INSTALLATION

- A. Pull boxes:
 - 1. A pull box shall be installed in conjunction with conduit installations to provide access to cables at appropriate locations for distribution to tributary locations, and to facilitate cable installation.
 - 2. Materials:
 - a. For indoor use, use NEMA Type 1 pull boxes.
 - b. For areas exposed to heavy moisture, chemicals or weather elements, NEMA Type 3 or 4 pull boxes shall be installed.
 - c. The pull box shall be equipped with hinged covers, or removable covers which are screwed or bolted on.
 - d. The pull boxes shall have hardware for supporting and securing cabling and pulling eyes to facilitate cabling installation.
 - 3. Install Pull boxes in easily accessible locations.
 - 4. A pull box shall be installed after 100 feet of conduit has been placed, and/or after 180 degrees of directional change in the conduit pathway has been affected.

5. A pull box should not be used in lieu of a bend.
 6. Conduits that enter the pull box from opposite ends with each other should be aligned.
 7. For direct access to a box located above inaccessible ceilings provide a suitable, marked, hinged access panel (or equivalent) in the ceiling. This access panel can also serve as the cover for the box.
 8. Support Requirements:
- B. Back Boxes
1. Provide 4-11/16" H X 4-11/16" W X 2-1/2" D outlet back boxes at all telecom outlet locations shown on drawings. Provide (1) 1-1/4" conduit from back box to applicable J-Hook pathway, telecom cable tray, telecom room or pull box except as otherwise noted. All connectors and couplings shall be zinc-plated steel set screw type. Die cast zinc fittings are not to be used. Provide bushing on ends of all conduits. Provide pull string in all conduits.
 2. Provide single gang plaster ring on all communications outlet back boxes, unless indicated otherwise.
 3. Provide bonding to cable tray pathways.
- C. Conduit support and bracing:
1. Coordinate layout and installation of conduits and pull boxes with other trade conditions to ensure adequate clearances, access and cable management.
 2. Install and provide support for EMT conduits and pull boxes in accordance with the latest edition of the NEC code, as well as all state and local codes and requirements. Coordinate installation and location with existing conditions. Notify and get the Owners Representative approval before installing conduits and pull boxes where the location need to deviate from the contract documents.
 3. Install conduits above ceilings at height to provide access to pull boxes and cable access to where conduits terminate to meet up with cable trays. Install conduits and pull boxes level and square and at proper elevations. Ensure adequate clearances, access and cable management.
 4. Use fittings and support devices compatible with conduits and pull boxes and suitable for use and location. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four.
 5. Install individual and multiple trapeze hangers and riser clamps as necessary to support the conduits. Provide U-bolts, clamp attachments and other necessary hardware for hanger assemblies and for securing hanger rods and conduits. Space supports for conduits on maximum 10-foot centers.
 6. Pull boxes shall be attached directly to the ceiling slab or suspended by point threaded rod supports anchored to the ceiling.
 7. Seismic bracing shall be installed as required by local building codes, DSA, and NUSIG (National Uniform Seismic Installation Guidelines).
 8. Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.
 9. Provide and install expansion or deflection fittings for conduits runs at all instances at seismic or expansion joints to allow for movement in any direction.
- D. Conduit routing, bends and radius guidelines:
1. If the conduit has an internal diameter of 2 inches or less the bend radius must be at least 6 times the internal conduit diameter.
 2. If the conduit has an internal diameter of more than 2 inches the bend radius must be at least 10 times the internal conduit diameter.
 3. Conduit bends should be smooth, even, and free of kinks or other discontinuities that may have detrimental effects on pulling tension or cable integrity during or after installation.
 4. If a conduit run requires more than two 90 degree bends then provide a pull box between sections with two bends or less.
 5. If a conduit run requires a reverse bend (between 100 degrees and 180 degrees) then insert a pull point or pull box at each bend having an angle from 100 degrees to 180 degrees.

6. Consider an offset as equivalent to a 90 degree bend.
7. Achieve the best direct route with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
8. Contain no continuous sections longer than 100 ft.
9. For runs that total more than 100 ft. in length, pull points or pull boxes should be inserted so that no segment between points/boxes exceeds the 100 ft. limit.
10. Withstand the environment to which they will be exposed.
11. Conduits should not be routed through areas in which flammable material may be stored or over or adjacent to boilers, incinerators, hot-water lines and steam lines.
12. Keep conduits at least 6' away from parallel runs of steam, hot water pipes or mechanical ductwork.

E. Conduit Terminations

1. Join conduits with fittings designed and approved for the purpose. Make the joints tight without protruding lips that can snag cable pulling inside the conduits.
2. Where conduits are terminated with locknuts and bushings align the conduit to enter squarely and install the locknuts with dished part against the box. Use two locknuts, one inside and one outside the box.
3. Ream all conduit ends and fit them with an insulated bushing to eliminate sharp edges that can damage cables during installation or service.
4. Conduits that enter a telecom room should terminate near the corners to allow for proper cable racking.
5. Terminate conduits that protrude through the structural floor 3 inches above the surface.
6. Maintain the integrity of all fire stop barriers for all floor or wall penetrations.

F. Provide grounding and bonding for conduits and pull boxes as indicated by NEC code and instructed by manufacturer.

G. Conduits shall be clearly labeled at both ends designating the opposite locations(s) served. The numbering scheme shall be room number plus a suffix to guarantee uniqueness, e.g., 143-1. Labeling must be machine generated.

H. Conduit Protection:

1. Remove burrs, dirt and construction debris from conduits and pull boxes.
2. Conduits should be left capped for protection.
3. Provide final protection and maintain conditions in a manner acceptable to the Owners Representative to ensure that coatings, finishes and pull boxes are without damage or deterioration at completion. Repair damage to galvanized finishes with zinc-rich paint recommended by the manufacturer.

I. Bonding and Grounding

Bonding of conduits to the Telecommunications Grounding System is required. At the termination of conduit runs within technology rooms, attachment of a ground wire between the Telecommunications Ground Bus to grounding rings installed on conduit box connectors should be accomplished to ensure electrical continuity of the conduit system.

J. Firestopping

K. Partially filled and empty conduits that pass through fire-rated walls or through floors shall be firestopped in accordance with Local Fire Codes. Material shall be flexible firestopping putty or pillows.

3.03 ACCEPTANCE

A. All specified conduits and pull boxes indicated on the drawings and specifications shall be complete.

- B. Specified shop drawings and product submittals shall have been submitted for review and all review comments and deficiencies shall have been resolved. Final shop drawings and product submittals shall have been submitted, reviewed and found to meet the requirements of the specifications.
- C. Issues and deficiencies identified in field reports and punch lists shall have been resolved. Final as-built drawings shall have been submitted, reviewed and found to meet the requirements of the specifications.
- D. Contractor shall provide written notice of final completion of the telecom infrastructure. Upon receipt, the Owner's Representative will review/observe the completed installation. Once the Owner's Representative is satisfied that all work is in accordance with the Contract Documents, the Contractor will be notified in writing.

3.04 RE-INSTALLATION

- A. No additional burden to the owner regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re- installation work shall be coordinated, in writing, with the owner prior to beginning any re- installation work
- B. CLOSEOUT ACTIVITIES
- C. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Owner and A/E team.
- D. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Owner

END OF SECTION

SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Peralta Community College District Datacom Infrastructure Standards

1.02 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Telecommunications service entrance pathways.
 - 5. Grounding.
- B. Related Sections:
 - 1. Division 27 Section "Basic Communication Requirements"
 - 2. Division 27 Section "Communications Backbone Cabling"
 - 3. Division 27 Section "Common Works for Communication"
 - 4. Division 27 Section "Communication Horizontal Cabling"
 - 5. Division 27 Section "Conduit Boxes Communication"

1.03 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- D. LAN: Local area network.
- E. RCDD: Registered Communications Distribution Designer.
- F. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.
- G. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.05 SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.

- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- D. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- E. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.08 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.
- C. Ladder cable trays:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - a. B-Line
 - b. Or Approved Equal
 - 2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by complying with ASTM B 633, Type 1, not less than 0.000472 inch thick.
 - a. Ladder Cable Trays as shown on drawings:
 - Nominally 18 inches wide, and a rung spacing of 12 inches.
 - B-Line#: SB17U18BFB
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.03 EQUIPMENT RACK

- A. Manufacturers: Subject to compliance with requirements:
 - 1. B-Line
- B. General Frame Requirements:
 - 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
 - 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. 2 - Post Racks: 19", 7' height, Modular-type, steel construction.
 - 1. Shall include vertical and horizontal cable management channels, as shown on drawings including and grounding lug.
 - 2. Baked-polyester powder coat finish.
 - B-Line#: SB556084XUFB
- D. 4 - Post Racks: 19", 7' height, Modular-type, steel construction.
 - 1. Shall include vertical and horizontal cable management channels, as shown on drawings including and grounding lug.
 - 2. Baked-polyester powder coat finish.
 - B-Line#: SB837084BFB

- E. Cable Management for Equipment Frames:
 - 1. Metal, with integral wire retaining fingers.
 - 2. Baked-polyester powder coat finish.
 - 3. Vertical cable management for 2-post and 4-post racks.
 - B-line (10" double sided) #: SB860810D084FB
 - 4. 2RU Horizontal cable management panels
 - B-Line #: SB87019D2FB
 - 5. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.
- F. Copper Patch Cords: Factory-made, 4-pair cables; terminated with 8-position modular plug at each end.
 - 1. Communication cabling contractor shall verify and confirm quantities, lengths and colors with owner prior procurement and installation. For pricing assume two patch cords for every terminated outlet. One patch cord at the floor side and one at the telecom room side.
 - 2. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6. Patch cords shall have latch guards to protect against snagging.
 - 3. Manufacturer:
 - Leviton/Berk-Tek
 - Leviton/Berk-tek - H6A10-07*
 - Leviton/Berk-tek - H6A10-10*

2.04 UPS

- 1. Provide 3KVA , rack mount UPS
 - Eaton 9PX3000RT
- 2. UPS mounting kit: Cabling contractor shall provide UPS mounting kit to support UPS.

2.05 POWER Distribution Unit

- A. Power Distribution Unit : One per each equipment rack.
 - Leviton # 5500-192

2.06 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
 - B-Line #: SBTMGB12
- C. Equipment Rack Ground Bus Bar
 - 1. One horizontal ground bus bar per Equipment Rack.
 - 2. B-Line#: SBTMGB20
- D. Comply with ANSI-J-STD-607-A.

2.07 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with Peralta Community College District Datacom Infrastructure Standards Labeling requirements

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.
- C. Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."
- D. Comply with NECA 1.
- E. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- F. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- G. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.02 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.03 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.04 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Labels shall be preprinted or computer-printed type.
- C. Comply with Peralta Community College District Datacom Infrastructure Standards Labeling requirements

END OF SECTION

**SECTION 27 1300
COMMUNICATIONS BACKBONE CABLING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS.

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Peralta Community College District Datacom Infrastructure Standards.
- C. Section Includes:
 - 1. Pathways.
 - 2. Copper cable.
 - 3. Multimode optical fiber cabling.
 - 4. Single-mode optical fiber cabling.
 - 5. Cable connecting hardware, patch panels, and cross-connects.
 - 6. Cabling identification products.
- D. Related Sections:
 - 1. Division 27 Section "Basic Communication Requirements"
 - 2. Division 27 Section "Communications Backbone Cabling"
 - 3. Division 27 Section "Common Works for Communication"
 - 4. Division 27 Section "Communication Horizontal Cabling"
 - 5. Division 27 Section "Conduit Boxes Communication"

1.02 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.03 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.05 SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C. Contractor shall meet Peralta Labeling standards, labeling scheme shall be submitted for approval prior commencing the labeling on field.
- D. Product Data: For each type of product indicated.
- E. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- F. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-C.
- E. Grounding: Comply with ANSI-J-STD-607-A.

F. DELIVERY, STORAGE, AND HANDLING

G. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. Test each pair of UTP cable for open and short circuits.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.08 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment service suppliers.

1.09 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Patch-Panel Units: One of each type.
 2. Connecting Blocks: One of each type.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-C.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 COPPER CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General cable
 2. Approved equal
- B. Description: 100-ohm, 50-pairs, covered with a gray thermoplastic jacket.
1. Outdoor rated cable shall be gel-filled AMNW type.
 2. Comply with ICEA S-90-661 for mechanical properties.
 3. Comply with TIA/EIA-568-C.1 for performance specifications.
 4. Comply with TIA/EIA-568-C.2, Category 5e and Category 3 cables.
 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following type:
 6. Communications, OSP Rated: 50-pairs, type CMR complying with UL 1666.
 - General Cable 25-pairs #: 2131550E
 - General Cable 50-pairs # : 7528144

2.03 COPPER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Leviton

2. Approved equal

- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Terminate 50-pair for outdoor in 110-block on the wall then crossconnect to 110-block on equipment rack#1.
 - 1. Leviton#:41DBR-1F5
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
 - 2. Leviton #: 41AB6-1F4
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- F. Cords are generally available in lengths to 20 feet and longer in 24-inch increments.

2.04 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek
 - 2. Panduit
- B. Description: Multimode (OM4) nonconductive, loose buffer, optical fiber cable and Singlemode (OS2) optical fiber cable.
 - 1. Outdoor backbone fiber optic cables shall be loose buffered – either multitube or core tube type, sheath consisting of a polyethylene jacket over
 - 2. the inner cable components (buffer(s), strength element, etc.). Comply with ICEA S-83-596 for mechanical properties.
 - 3. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 4. Comply with TIA/EIA-492AAAA-B for detailed specifications.
 - 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following type:
 - 6. Conductive cable shall be aluminum armored type.
 - 7. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 - 8. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
 - 9. Outdoor use:
 - 24-strands of singlemode (OS2) Berk-Tek#: PDPK012AB0707-I/O-C4C5(YEL)
 - 12-strands of multimode (OM4) Berk-Tek#: PDPK012FB3010/F5-I/O-C4(AQU)
 - 10. Indoor Jacket Color: Yellow for Single-mode
 - 11. Indoor Jacket Color: Aqua for Multimode
 - 12. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 13. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.05 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Leviton

- B. Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
 - 2. 1 RU Fiber patch panel Leviton #:5R1UH-S03
- C. Fiber Adapter Panels
 - 1. Singlemode-12 LC Leviton #: TBD
 - 2. Multimode - 12 LC Leviton #: TBD
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
 - ** Communication cabling contractor shall verify and confirm with owner patch cords quantities , connector type, lengths and colors prior procurement and installation. **
 - 1. Leviton singlemode #: TBD
 - 2. Leviton multimode #: TBD
- E. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - 2. Quick-connect, simplex and duplex, Type LC singlemode and SC multimode connectors. Insertion loss not more than 0.75 dB.
 - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.
 - 4. LC singlemode connectors - Termination (per pair, per end): TBD
 - 5. LC multimode connectors - Termination (per pair, per end): TBD

2.06 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.07 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.08 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.03 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 1. Comply with TIA/EIA-568-B.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. In the communications equipment room, install a 10-foot long service loop on each end of cable.
 10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Group connecting hardware for cables into separate logical fields.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches .
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Contractor shall meet Peralta Labeling standard requirements
 - 5. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 6. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION

**SECTION 27 1500
COMMUNICATIONS HORIZONTAL CABLING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Peralta Community College District Data Infrastructure Standards

1.02 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP and Coax cabling.
 - 3. Cable connecting hardware, patch panels, and cross-connects.
 - 4. Telecommunications outlet/connectors.
 - 5. Cabling system identification products.
 - 6. Cable management system.
- B. Related Sections:
 - 1. Division 27 Section "Basic Communication Requirements"
 - 2. Division 27 Section "Communications Backbone Cabling"
 - 3. Division 27 Section "Common Works for Communication"
 - 4. Division 27 Section "Communication Horizontal Cabling"
 - 5. Division 27 Section "Conduit Boxes Communication"
 - 6. Division 26 Section "Raceways and Boxes" for floor boxes requirements shown under Technology drawings. Floor boxes shall be coordinated with electrical drawings and specifications.

1.03 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. IDC: Insulation displacement connector.
- G. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- H. LAN: Local area network.
- I. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- J. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- K. RCDD: Registered Communications Distribution Designer.

- L. UTP: Unshielded twisted pair.

1.04 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.05 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C, when tested according to test procedures of this standard.

1.06 SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C. Product Data: For each type of product indicated.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
 - 2. For category 6 cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- D. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

- d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- E. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.
- F. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Maintenance Data: For splices and connectors to include in maintenance manuals.
- J. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings Cabling Administration Drawings, and field-testing program development by RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: UL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-B.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Test all cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.
- B. Packaging and shipping
 - 1. Deliver materials and equipment in time for inspection, and tests in accordance with approved project schedule. Coordinate delivery schedule with the Construction Manager.
 - 2. All shipment arrangements for unloading at site shall be made with the Construction Manager twenty-four hours prior to the delivery.

3. Movement of material, either at the time of delivery or subsequently, shall be the sole responsibility of the Communications Contractor. All costs involved with the movement shall also be the responsibility of the Communications Contractor.
4. Where necessary, ship equipment in containers or boxes of appropriate size to permit passing through available spaces.

C. Storage and protection

1. Neatly pile and store loose materials at job site under watertight cover on wood blocking or in suitable areas away from damp surfaces as designated by the Construction Manager.
2. Protect existing work that may be damaged during subsequent construction and other normal activities.

D. Clean Up and Storage

1. The contractor shall abide by all terms and conditions of the Construction Manager regarding the removal of trash and work area clean-up.
2. Prior to acceptance of work, all areas used or entered by the Communications Contractor must be cleared of any materials or debris caused directly or indirectly by the Communications Contractor to the satisfaction of the Owner or its duly authorized representative.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA-569-B.
- B. Cable Support: UL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks and D-rings.
 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems". Flexible metal conduit shall not be used.
1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 UTP CABLE

- A. Manufacturers:
1. Leviton/Berk-tek
 2. Panduit

- B. Description: 100-ohm, Category 6A, 4-pair UTP covered with a thermoplastic jacket colors listed below.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA-568-C, Category 6A.
 - 3. Listed and labeled by an UL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - b. Berk-Tek #: 11101842

2.03 TRAVEL CABLE FOR ELEVATOR CAB

- A. Manufactured : Draka or approved equal
 - 1. Cable shall comply with NEC 620.12 requirements
 - 2. Cable Draka# 18-322-05
 - 3. Mesh Grip Draka# 024-20-1504

2.04 UTP CABLE HARDWARE

- A. Manufacturers: Leviton/Berk-tek
- B. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
 - 2. Category 6A Copper Patch Panel (24 ports) Leviton: 6A586-U24
 - 3. Category 6A Copper Patch Panel (48 ports) Leviton: 6A586-U48
- C. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
 - 1. Category 6, RJ 45 jacks:
 - Leviton: 6110G-R*6
 ** Communication cabling contractor shall verify all jack colors with architect, owner prior procurement and installation. **
- D. Patch Cords: Communication contractor shall confirm patch cords color , quantities, lengths and colors with Merritt prior to procurement and installation. For pricing purposes assume two patch cords per terminated outlet one for the floor side and one at the telecom room side.
 - 7' patch cored Leviton #: H6A10-07*
 - 10'patch cored Leviton #: H6A10-10*

2.05 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-C.
- B. Workstation Outlets: Number of ports-connector assemblies mounted in single faceplate listed below.
 - 1. Faceplate:
 - 2. Single Gang Faceplate:
 - Leviton - 1 port #:42080-1WS
 - Leviton - 2 port #:42080-2WS
 - Leviton - 3 port #:42080-3WS
 - Leviton - 4 port #:42080-4WS
 - Leviton - 2 port Biscuit: 41089-2WP
 - Leviton - 6 port #: 42080-6WS
 - Modular Furniture Feeds#: 49910-SW4 (white)
 **Cabling contractor shall provide cutsheets to architect and owner prior procurement and installation for concurrence and approval on color.

3. Legend: Machine printed, in the field, using adhesive-tape label.
4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.06 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-B.

2.07 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.08 SOURCE QUALITY CONTROL

- A. Factory test UTP cables according to TIA-568-C.
- B. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways when possible except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

- F. Pathway Installation in Communications Equipment Rooms:
 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.03 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 1. Comply with TIA-568-C.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 66-style IDC termination hardware unless otherwise indicated.
 4. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 5. Terminate conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 60 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 10. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 11. In the communications equipment room, install a 10-foot long service loop on each end of cable.
 12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 1. Comply with TIA-568-C.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.

- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches .
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches .
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches .
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches .

3.04 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
 1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

- C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration, including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA-606-B. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet .
 - 3. Terminal strip in each cabinet, rack, or panel.
 - a. Identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 5. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labeling shall comply label scheme Peralta Community College District Data Infrastructure Standards
- I. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA-606-B.
 - 1. Cables label use flexible vinyl or polyester that flex as cables are bent.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Cabling contractor to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP cable jacket materials UL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.
 - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA-568-C. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- 5. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA-568-C :
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
- 6. Coaxial Cable Tests: Conduct tests according to BICSI TDMM "Field Testing chapter".
- 7. Final Verification Tests: Perform verification tests for UTP after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be submitted in native format.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION

**SECTION 27 5116
PUBLIC ADDRESS SYSTEMS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Preamplifiers.
 2. Power amplifiers.
 3. Transfer to standby amplifier.
 4. Microphones.
 5. Volume limiter/compressors.
 6. Control console.
 7. Equipment cabinet.
 8. Equipment rack.
 9. Telephone paging adapters.
 10. Tone generator.
 11. Monitor panel.
 12. Loudspeakers.
 13. Noise-operated gain controllers.
 14. Microphone and headphone outlets.
 15. Battery backup power unit.
 16. Conductors and cables.
 17. Pathways.

1.03 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. VU: Volume unit.
- C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.04 ACTION SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C. Product Data: For each type of product.
- D. Shop Drawings: Power, signal, and control wiring.
 1. Include plans, elevations, sections, and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Console layouts.
 4. Control panels.

5. Rack arrangements.
 6. Calculations: For sizing backup battery.
 7. Wiring Diagrams: For power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.
- E. Contractor shall provide supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data: For Installer.
- C. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Include qualification data for testing agency.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For public address systems to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017700 "Closeout Procedures" and Section 017823 "Operation and Maintenance Data," include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to operating console location.
 - c. Training plan.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Microphone: One.
 2. Microphone Desk Stand(s): One.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 1. Personnel certified by NICET as Audio Systems Level II Technician.
- B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.

1. Testing Agency's Field Supervisor: Currently certified by NICET at Level III to supervise on-site testing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 2. Bogen Communications, Inc.
 3. Valcom.
 4. Approved Equal by owner.

- B. Source Limitations: Obtain public address system from single source from single manufacturer.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Comply with NFPA 70.

2.02 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. System Functions:
 1. Selectively connect any zone to any available signal channel.
 2. Selectively control sound from microphone outlets and other inputs.
 3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
 4. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
 5. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
 6. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.03 PERFORMANCE REQUIREMENTS

- A. Contractor shall provide supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Seismic Performance: Supports and seismic restraints for control consoles, equipment cabinets and racks, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.04 SYSTEM DESCRIPTION

- A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

- B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

- C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch housing complying with EIA/ECA-310-E.

- D. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

2.05 PREAMPLIFIERS

- A. Preamplifier: Separately mounted.
- B. Preamplifier: Integral to power amplifier.
- C. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.
- D. Total Harmonic Distortion: Less than 1 percent.
- E. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.
- F. Input Jacks: Minimum of three. One matched for low-impedance microphone; one USB port; and the other matchable to DVD or CD player, or radio tuner signals without external adapters.
- G. Minimum Noise Level: Minus 55 dB below rated output.
- H. Controls: On-off, input levels, and master gain.

2.06 POWER AMPLIFIERS

- A. Mounting: Rack.
- B. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus a 20 percent allowance for future stations.
- C. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.
- D. Minimum Signal-to-Noise Ratio: 80 dB, at rated output.
- E. Frequency Response: Within plus or minus 3 dB from 20 to 12,000 Hz.
- F. Output Regulation: Less than 2 dB from full to no load.
- G. Controls: On-off, input levels, and low-cut filter.
- H. Input Sensitivity: Matched to preamplifier and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

2.07 TRANSFER TO STANDBY AMPLIFIER

- A. Monitoring Circuit and Sensing Relay: Detect reduction in output of power amplifier of 40 percent or more and, in such event, transfer load and signal automatically to standby amplifier.

2.08 MICROPHONES

- A. Paging Microphone:
 - 1. Type: Dynamic, with cardioid omnidirectional polar characteristic.
 - 2. Impedance: 500 ohms.
 - 3. Frequency Response: Uniform, 50 to 15,000 Hz.
 - 4. Sensitivity: Minus 70 dB.
 - 5. Output Level: Minus 58 dB, minimum.
 - 6. Cable: Braided shield cable with XLR connectors. Coordinate impedance with microphone impedance.
 - 7. Mounting: Desk stand with integral-locking, press-to-talk switch.

2.09 VOLUME LIMITER/COMPRESSOR

- A. Minimum Performance Requirements:
 - 1. Frequency Response: 45 to 15,000 Hz, plus or minus 1 dB minimum.
 - 2. Reduction Ratio: Automatically vary compression ratio, and attack and release times for voice and music inputs.
 - a. Compression Ratio Range: 3:1 to 10:1 minimum.

- b. Averaging Compressor Attack Time: Up to 500 milliseconds.
- c. Signal Fast Compression Attack Time: Less than 10 milliseconds.
- d. Release time: Up to 500 milliseconds.
- 3. Distortion: 0.5 percent, maximum.
- 4. Rated Output: Minimum of plus 14 dB.
- 5. Inputs: Minimum of two inputs with variable front-panel gain controls and VU or decibel meter for input adjustment.
- 6. Rack mounted.

2.10 CONTROL CONSOLE

- A. Cabinet: Modular, desk style; complying with EIA/ECA-310-E.
- B. Housing: Steel, 0.0478 inch minimum, with removable front and rear panels. Side panels are removable for interconnecting side-by-side mounting.
- C. Panel for Equipment and Controls: Rack mounted.
- D. Controls:
 - 1. Switching devices to select signal sources for distribution channels.
 - 2. Program selector switch to select source for each program channel.
 - 3. Switching devices to select zones for paging.
 - 4. All-call selector switch.
- E. Indicators: A visual annunciation for each distribution channel to indicate source being used.
- F. Self-Contained Power and Control Unit: A single assembly of basic control, electronics, and power supply necessary to accomplish specified functions.
- G. Spare Positions: 20 percent spare zone control and annunciation positions on console.
- H. Microphone jack.

2.11 EQUIPMENT CABINET

- A. Comply with EIA/ECA-310-E.
- B. House amplifiers and auxiliary equipment at each location.
- C. Cabinet Housing:
 - 1. Constructed of 0.0478-inch steel, minimum, with front- and rear-locking doors and standard EIA/ECA-310-E-compliant, 19-inch racks.
 - 2. Arranged for floor or wall mounting as indicated.
 - 3. Sized to house all equipment indicated, plus spare capacity.
 - 4. Include 20 percent minimum spare capacity for future equipment in addition to space required for DVD or CD player.
- D. Power Provisions: A single switch in cabinet shall disconnect cabinet power distribution system and electrical outlets, which shall be uniformly spaced to accommodate ac-power cords for each item of equipment.
- E. Ventilation: A low-noise fan for forced-air cabinet ventilation. Fan shall be equipped with a filtered input vent and shall be connected to operate from 105- to 130-V ac, 60 Hz; separately fused and switched; arranged to be powered when main cabinet power switch is on.

2.12 EQUIPMENT RACK

- A. Racks: 19 inches standard, complying with EIA/ECA-310-E.
- B. Power-Supply Connections: Compatible plugs and receptacles.

- C. Enclosure Panels: Ventilated rear and sides and solid top. Use louvers in panels to ensure adequate ventilation.
- D. Finish: Uniform, baked-enamel factory finish over rust-inhibiting primer.
- E. Power-Control Panel: On front of equipment housing, with master power on-off switch and pilot light; and with cartridge fuse protection for rack equipment power.
- F. Service Light: At top rear of rack with an adjacent control switch.
- G. Vertical Plug Strip: Grounded receptacles, 12 inches o.c.; the full height of rack for public address system equipment use only.
- H. Maintenance Receptacles: Duplex convenience outlets supplied independent of vertical plug strip and located in front and bottom rear of rack.
- I. Spare Capacity: 20 percent in rack for future equipment.

2.13 TELEPHONE PAGING ADAPTER

- A. Adapters shall accept voice signals from telephone extension dialing access and automatically provide amplifier input and program override for preselected zones.
 - 1. Minimum Frequency Response: Flat, 200 to 2500 Hz.
 - 2. Impedance Matching: Adapter matches telephone line to public address equipment input.
 - 3. Rack mounted.

2.14 TONE GENERATOR

- A. Tone generator shall provide clock and program interface with public address system.
- B. Signals: Minimum of seven distinct, audible signal types including wail, warble, high/low, alarm, repeating and single-stroke chimes, and tone.
- C. Pitch Control: Chimes and tone.
- D. Volume Control: All outputs.
- E. Activation-Switch Network: Establishes priority and hierarchy of output signals produced by different activation setups.
- F. Mounting: Rack.

2.15 MONITOR PANEL

- A. Monitor power amplifiers.
- B. Components: VU or dB meter, speaker with volume control, and multiple-position rotary selector switch.
- C. Selector Switch and Volume Control: Selective monitoring of output of each separate power amplifier via VU or dB meter and speaker.
- D. Mounting: Rack.

2.16 LOUDSPEAKERS

- A. Cone-Type Loudspeakers:
 - 1. Minimum Axial Sensitivity: 91 dB at 1 m, with 1-W input.
 - 2. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
 - 3. Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
 - 4. Rated Output Level: 8 W.
 - 5. Minimum Dispersion Angle: 100 degrees.
 - 6. Matching Transformer: Full-power rated with four taps. Maximum insertion loss of 0.5 dB.

7. Surface-Mounted Units: Ceiling, wall, or pendant mounted, as indicated, in steel back boxes, acoustically dampened. Front face of at least 0.0478-inch steel and whole assembly rust proofed and shop primed for field painting.
8. Flush-Ceiling-Mounted Units: In steel back boxes, acoustically dampened. Metal ceiling grille with white baked enamel.

B. Horn-Type Loudspeakers:

1. Type: Single-horn units, double-reentrant design, with minimum full-range power rating of 15 W.
2. Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.
3. Frequency Response: Within plus or minus 3 dB from 250 to 12,000 Hz.
4. Dispersion Angle: 130 by 110 degrees.
5. Mounting: Integral bracket.
6. Units in Damp, Wet, or Outdoor Locations: Listed and labeled for environment in which they are located.
7. Units in Hazardous (Classified) Locations: Listed and labeled for environment in which they are located. Provide any accessories required to maintain listing.

2.17 NOISE-OPERATED GAIN CONTROLLER

- A. Gain controller shall be designed to continuously sense space noise level and automatically adjust signal level to local speakers.
- B. Frequency Response: 20 to 20,000 Hz, plus or minus 1 dB.
- C. Level Adjustment Range: 30 dB minimum.
- D. Maximum Distortion: 0.5 percent.
- E. Control: Permits adjustment of sensing level of device.

2.18 OUTLETS

- A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.
 1. Wattage Rating: 10 W unless otherwise indicated.
 2. Attenuation per Step: 3 dB, with positive off position.
 3. Insertion Loss: 0.4 dB maximum.
 4. Attenuation Bypass Relay: SPDT. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
 5. Label: "PA Volume."
- B. Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.
- C. Headphone Outlet (for the Hearing Impaired): Microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed-outlet covers.

2.19 BATTERY BACKUP POWER UNIT

- A. Unit shall be rack mounted, consisting of time-delay relay, sealed lead-calcium battery, battery charger, on-off switch, "normal" and "emergency" indicating lights, and adequate capacity to supply maximum equipment power requirements for one hour of continuous full operation.
- B. Unit shall supply public address equipment with 12- to 15-V dc power automatically during an outage of normal 120-V ac power.

- C. Battery shall be on float charge when not supplying system and able to transfer automatically to supply system after three to five seconds of continuous outage of normal power, as sensed by time-delay relay.
- D. Unit shall automatically retransfer system to normal supply when normal power has been reestablished for three to five seconds continuously.

2.20 CONDUCTORS AND CABLES

- A. Jacketed, twisted pair and twisted multipair, untinned solid copper.
 - 1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch thick.
 - 2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
 - 3. Plenum Cable: Listed and labeled for plenum installation.

2.21 PATHWAYS

- A. Conduit and Boxes: Comply with Section 270528 "Pathways for Communications Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be not less than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

PART 3 - EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for pathways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF PATHWAYS

- A. Comply with requirements in Section 270528 "Pathways for Communications Systems." for installation of conduits and wireways.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.03 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Cable Installation Requirements:
 - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 - 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 - 3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
- C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other communication equipment conductors as recommended by equipment manufacturer.

3.04 INSTALLATION

- A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- C. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- D. Equipment Cabinets and Racks:
1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
 2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
- E. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.
- F. Wall-Mounted Outlets: Flush mounted.
- G. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.
- H. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- I. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

- J. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.
- K. Connect wiring according to Section 271500 "Communications Horizontal Cabling" and Section 280513 "Conductors and Cables for Electronic Safety and Security."

3.05 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Section 270526 "Grounding and Bonding for Communications Systems."

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 - 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
 - b. Repeat test for each separately controlled zone of loudspeakers.
 - c. Minimum acceptance ratio is 50 dB.
 - 5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 - 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 - 7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
 - 8. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Section 270526 "Grounding and Bonding for Communications Systems."

- E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
- F. Public address system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
 - 1. Include a record of final speaker-line matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

3.07 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 - 2. Complete installation and startup checks according to manufacturer's written instructions.

3.08 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address system and equipment. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

**SECTION 27 5126
ASSISTIVE LISTENING SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Assistive listening kit system.

1.02 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include configurations, dimensions, finishes, and service condition requirements.
- B. Manufacturer's certification that products meet or exceed specified requirements.
- C. Operation and Maintenance Data: Include detailed information on system operation, equipment setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.04 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Assistive Listening Systems:
 - 1. Williams AV, LLC: FM ADA Compliance Kit FM ADA KIT 37 RCH with Rechargeable Battery: info@williamsav.com.
- B. Source Limitations: Furnish system components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 ASSISTIVE LISTENING SYSTEMS

- A. Provide new portable assistive listening systems kit consisting of all required equipment, hardware, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
 - 1. Kit includes the following Equipment:
 - a. One transmitter.
 - b. Four receivers with rechargeable batteries, headphones, neckloops, and a microphone.
 - c. battery chargers.
 - d. Carrying case.
- B. PPA T46 Transmitter: Wide-band body-pack transmitter and shall operate on 17 selectable frequencies between 72MHz and 76MHz.
 - 1. Enclosure Material: Shatter-resistant PC/ABS plastic with textured scratch-resistant aluminum faceplate.

2. Battery Type: Two AA 1.5 V NiMH rechargeable batteries (BAT 026-2), 75 mA nominal current drain, up to 20 hours battery life per charge, recharges in 14–16 hours, uses CHG 3502 or CHG 3512 Charger.
 3. Operating Frequencies: Selectable, 17 channels, 72.1 – 75.9 MHz*. Switchable 8 or 17 Channel Mode. (8-channel mode setting corresponds with PPA R35-8 receiver channels).
 4. Stability: $\pm .005\%$, frequency synthesized, crystal reference, PLL
 5. Modulation: Wide-band FM, 75 kHz peak, 75 μ S pre-emphasis.
 6. RF Output: 80 mV/m at 3 m.
 7. Frequency Response: 180 Hz to 13 kHz, ± 3 dB at 1% max. THD Signal-to-Noise.
 8. Ratio: 65 dB (typical) transmitted.
 9. Transmit Antenna: Integral with microphone cord.
 10. Microphone: Electret type, 3.5 mm mono plug.
 11. External Display: OLED for status and menu information.
 12. Status: Ch/Freq, Mic Audio Level, Auxiliary Input Audio Level, Battery Status, Mic Mute, Channel Lock, Dual-Preset mode. Menu: Ch/Freq display mode select, Volume, Aux Input, Compression, 17 or 8-channel mode, screen time out, screen brightness, restore default settings.
 13. External Controls: Momentary push button: push and hold 3 seconds for power On/Off, push and release for microphone mute On/Off. “Up”, “Down” and “Menu” buttons for accessing and changing transmitter settings. Battery type switch (Alkaline or NiMH) located behind the battery compartment door.
 14. External Indicators: Power LED - Green, flashes when battery is low.
 15. Mic Input: 3.5 mm mono jack with electret mic bias, adjustable gain with 25 dB range.
 16. Aux Input: 2.5 mm stereo jack, adjustable gain with 60 dB range.
 17. Audio Compression: 1:1 (off) or 2:1 (on) selectable in menu.
- C. PPA R37 FM Receiver: Provide the following:
1. Encased in black, PC/ABS impact-resistant plastic with a hinged battery door.
 2. Body-pack style and include a detachable belt-clip for hands-free operation.
 3. 3.5mm stereo/mono jack to accommodate stereo or mono low impedance earphones, headphones and neckloops.
 4. Combination volume control with power on/off rotator dial.
 5. Green LED indicating battery and system status codes.
 6. Access to 17 preset wideband channels between 72-76MHz*.
 7. Channel Selection: Made by pushing the seek button inside the battery compartment with channel-lock capability.
 8. Slide switch inside the battery compartment to select disposable Alkaline or NiMH rechargeable battery operation.
 9. Charger Contacts: Bottom of the receiver for use with Williams Sound drop-in chargers CHG 3512 and CHG 3502.
 10. Operating Time: 50 hours with two disposable AA Alkaline batteries and up to 32 hours with two AA NiMH rechargeable batteries (BAT 026).
 11. Provide a maximum out of 35mW at 16 ϕ with an earbud type earphone.
 12. Audio Frequency Response: 200Hz to 15kHz ± 3 dB and the signal to noise ratio shall be 65dB min.
 13. Sensitivity: 2 μ V or better at 12dB Sinad with squelch defeated.
 14. Accept up to ± 75 kHz FM deviation and have a 75 μ s de-emphasis time constant.
 15. The R37 shall have FCC, Industry Canada approvals and be compliant with RoHS and WEEE regulations. The receiver shall be covered by a Lifetime PLUS Limited Warranty, 90 Days on most accessories.
 16. This receiver model shall be the Williams Sound model PPA R37.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

END OF SECTION

**SECTION 27 5313
CLOCK SYSTEMS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 1. Master clock control unit.
 2. Secondary indicating clocks.
 3. Program signal devices.
 4. Clock circuit power boosters.
 5. Interface with public-address system.
 6. System wire and cable.
- B. Synchronized clock program system and stand-alone and independent analog and digital clocks and bells.

1.03 DEFINITIONS

- A. NIST: The National Institute of Science and Technology.
- B. PC: Personal computer.
- C. UTC: Universal time coordinated. The precisely measured time at zero degrees longitude; a worldwide standard for time synchronization.

1.04 ACTION SUBMITTALS

- A. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work.
- B. Contractor is responsible to provide complete wiring diagram, elevations and details to convey understanding of scope of work as part of the shop drawings.
- C. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes (including available colors) for each product indicated and describe features and operating sequences, both automatic and manual, for the following:
 1. Master unit.
 2. Indicating clocks.
 3. Signal equipment.
 4. Equipment enclosures and back boxes.
 5. Accessory components.
 6. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Shop Drawings: For clock systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring and correction circuits.
 - a. Identify terminals and wiring color codes to facilitate installation, operation, and maintenance.

- b. Indicate recommended wire types and sizes, and circuiting arrangements for field-installed system wiring. Show protection from overcurrent, static discharge, and voltage surge.
 - c. Floor plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to Owner prior to installation.
2. Details of seismic restraints including mounting, anchoring, and fastening devices for the following system components:
 - a. Surface-mounted and semirecessed secondary indicating clocks.
 - b. Master clock mounting racks.
 - c. Clock circuit power boosters.
 3. Details of seismic strengthening of master clock mounting racks.
 4. Dimensioned Outline Drawings of the Mounting Rack for the Master Clock:
 - Show internal seismic bracing, and locate center of gravity of fully equipped and assembled unit. Locate and describe mounting and anchorage provisions.
- E. Samples for Initial Selection:
1. Manufacturer's color photographs or color chips showing the full range of colors available for clocks, signal equipment, and control panels.
 2. Representative operating models of clock type 12.5" Traditional clocks with -P (Calypso), black surface.
- F. Delegated-Design Submittal: For the master clock and housing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of the master clock and housing.
 2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for the master clock, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For clock and program control to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Work shall be performed by a manufacturer certified installer.
- D. Installer must have successfully completed at least five projects of equal scope in the past five years, and have been in business of furnishing and installing clock and program systems of this type for at least five years.
- E. Installer must be a factory authorized distributor and service provider for the brand of equipment offered and shall provide proof upon request.

- F. Installer must maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system for at least two years after Substantial Completion

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Master clock and housing shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. All new clocks shall integrate with existing Campus Clock system. Contractor shall validate all requirements with Merritt College prior to procurement, installation and provide Merritt College fully function Master Clock system.

2.02 MASTER AND SECONDARY CLOCK SYSTEM

- A. System Functions and Features:
 - 1. Maintain correct synchronized time and transmit time-correction signals over dedicated system wiring from a master clock to any one type(s) of secondary indicating clocks, including the following:
 - 2. Initiate and execute programs for scheduled automatic operation of remote devices. Include audible signal devices and visual signal devices.
 - 3. Provide for manual control of programmed signal and equipment-switching circuits.
 - 4. Communicate with remote PC for access to UTC time base and to permit programming from remote location.
 - 5. Maintain system access security with a minimum of one level of user-access control to restrict use of system controls to authorized personnel. Access to user programming and control functions is accomplished by entering a minimum three-digit code. Access levels include the following:
 - a. Access to review existing programs only.
 - b. Access to normal system operating controls.
 - c. Access to all user-programming and control functions.
 - 6. Regulate system timing functions using power-line frequency, backed up for power outages by an internal battery-powered, crystal-controlled oscillator.
 - 7. Provide for programming multiple independent event schedules into memory and running them simultaneously for different output circuits.
 - a. Quantity of Programmable Schedules: 18 minimum.
 - b. Number of Weekly Events That Can Be Programmed for Each Schedule: 300, minimum.
 - c. Simultaneous operation of independent schedules shall be limited only by the number of signal-device and equipment-switching output circuits.
 - d. Advance Programming for Automatic Holiday Schedule Changes: Number of schedule changes that can be programmed to suit holidays and vacations shall be 50, and each change may be programmed up to a year in advance to occur on any day of the calendar year.
 - 8. Provide manually initiated daylight savings time correction.
 - 9. Provide for adjustments to master clock output signals. Duration of momentary signal shall be individually programmable for each signal and equipment-control output circuit from 1 to 99 seconds. Signals shall be programmable for either on or off switching to suit equipment-operation scheduling.

2.03 MASTER CLOCK

- A. Description: Microprocessor-based, software-controlled unit complying with Class A device requirements in 47 CFR 15.
 - 1. Programming and control switches.
 - a. Provides programming cues when system is being programmed.
 - 2. Output Circuits for Power and Correction of Secondary Indicating Clocks:
 - 3. Modem and PC interface software suitable for remote programming.
 - 4. Circuits for Audible and Visual Signal Devices: Relay controlled, manually switchable, using controls on the master clock. Rated 120-V ac, five A minimum. A minimum of two circuits.
 - 5. Circuits for Programmable Switching of Remote Equipment and Circuits: Relay controlled, manually switchable, using controls on the master clock. Rated 120-V ac, 5 A minimum. A minimum of circuits.
 - 6. Power Supplies: Capacity for internal loads and power-and correction circuits of connected clocks.
 - 7. Enclosure: Metal cabinet with locking front panel. When cabinet is locked, display indication shall be visible on or through front panel face. Arrange cabinet for surface, semirecessed, or flush mounting as indicated.
 - 8. Housing: Rack-mounting metal enclosure with display indication visible on front panel face.
 - a. Reinforce mounting and attachment capable of resisting seismic forces described in Section 270548.16 "Seismic Controls for Communications Systems."
 - 9. Battery Backup for Time Base: Lithium battery to maintain the timekeeping function and retain the programs in memory during outage of normal ac power supply for up to 10 years.
 - 10. Electrostatic Discharge Resistance: Master clock shall be tested and certified according to IEC 61000-4-2 in both human-discharge and direct-injection modes.

2.04 SECONDARY INDICATING CLOCKS

- A. Analog Clock: Equipped with a sweep second hand. Movement shall be driven by self-starting, permanently lubricated, sealed synchronous motor equipped with a correcting solenoid actuator, or be a microprocessor-based, second impulse unit, compatible with the master clock.
- B. Digital Clock: Microprocessor-controlled unit complying with Class A device requirements in 47 CFR 15, with red LED digital time display of hours, minutes, and seconds.
 - 1. Display Height: 2-1/2-Inch Clock: Hour and minute numerals readable at 50 feet.
 - 2. Display Height: 4-Inch Clock: Hour and minute numerals readable at 100 feet.
 - 3. Display Format: Selectable between 12-hour with "PM" LED display and 24-hour formats.
 - 4. Connections for Power and Correction:
 - a. Wired synchronous connection to the master clock for both operating power and correction.
 - 1) Time-Base Backup: Internal alkaline battery shall back up internal time base to maintain timekeeping during power outages of up to six days' duration.
 - b. Correction by RS485, Ethernet, or similar data line with operating power supplied over a separate connection.
 - c. Power Connection for Secondary Indicating Clocks: Plug connector.
- C. Interval-Timer Clock: Digital microprocessor-controlled, 4-inch unit with 2-1/2-inch, red LED digital display for hours and minutes and 1-5/16-inch display for seconds; a separately mounted, mode-control switch; and the following features:
 - 1. Display Visibility: Hour and minute numerals readable at 30 feet in normal ambient light.
 - 2. Operating Modes:
 - a. Normal: Clock operates as a regular secondary system clock, displaying corrected time in normal display configuration, selectable between 12- and 24-hour formats, with "PM" digital display for 12-hour format.
 - b. Count-Down or Count-Up Timer: Selected by mode-control switch count-up and count-down positions, and capable of being preset at the mode-control station.
 - c. Clock shall revert to normal operating mode when the initiating-signal system is reset.

3. Mode-Selector Switch: Push-button or rotary, multiposition type, flush mounted; with start, stop, and reset capability in both count-up and count-down modes.
 4. Audible tone signal: Housed in clock or mode-selector-switch box. Sounds at end of preset up or down count.
- D. Provision for Time-Tone-Unit Installation: Equip indicated clocks for housing or mounting in an acoustically treated and baffled speaker compartment specified in Section 275116 "Public Address and Mass Notification Systems."
- E. Secondary Indicating Clock Characteristics:
1. Clock Type: GPS synchronized time system ,. 12.5" Traditional clocks with -P (Calypso)
 2. Face Configuration: Single.
 3. Mounting: Surface.
 4. Nominal Dimensions: 12.5"
 5. Casing Finish: Black
 6. Special Environmental Conditions: None
 7. Dial Face Color: Black
 8. Analog Clock Crystal: Clear.
 9. Face Color: White
 10. Seconds Display: Yes.
 11. Battery Backup: Yes.
 12. Interval-Timer Display: Yes.

2.05 PROGRAM SIGNAL DEVICES

- A. Bells: Heavy-duty, modular, vibrating type with the following sound-output ratings measured at 10 feet:
1. 4-Inch Bell: 90 dB.
 2. 6-Inch Bell: 95 dB.
 3. 10-Inch Bell: 104 dB.
- B. Chimes: Heavy-duty, modular, vibrating chimes with polished-chrome tone bar and enamel-finished housing. Minimum sound-output rating measured at 10 feet shall be 75 dB.
- C. Clock Buzzers: Adjustable output signal device designed for mounting within clock housing or outlet box.
1. Sound-Output Rating Measured at 3 Feet: 75 dB.
 2. Audible Tone Frequency: Manufacturer's standard between 120 Hz and 2 kHz.
- D. Horns: Modular, adjustable-output, vibrating type with minimum full-intensity-rated sound output of 103 dB measured at 10 feet.
- E. Projector Horns: Adjustable-output, vibrating type with single projector arranged to channel sound in the direction of the projector axis, and with minimum full-intensity-rated sound output of 104 dB measured at 10 feet.
- F. Loudspeakers for Audible Tones
- G. Visible Signal Devices: Strobe lights with blue polycarbonate lens and xenon flash tube, with lens mounted on an aluminum faceplate and the word "Program" engraved in letters at least 1 inch high on lens. Lamp unit shall have a minimum rated light output of 75 candela.
- H. Combination Audible and Visible Signal Devices: Factory-integrated horn and strobe light in a single mounting assembly.
- I. Outdoor Signal Equipment: Weatherproof models listed for outdoor use.
- J. Mounting Arrangement for Signal Devices: Designed for attachment with screws on the mounting plate of a flush-mounted back box unless otherwise indicated.

- K. Enclosures for Flush-Mounting Bells and Horns: Enclosure, mounting plate, and grille assembly shall be furnished by device manufacturer to match features of the device to be mounted. Enclosure shall be recessed in wall, completely enclosing the device, with grille mounting over the open side of the enclosure and flush with the wall.
- L. Connection Provision for Signal-Indicating Devices: Plug connector.

2.06 CLOCK CIRCUIT POWER BOOSTER

- A. Description: Transformer power supply, mounted in steel cabinet with hinged door, and having fuse-protected input and output circuits.

2.07 BACK BOXES FOR SECONDARY INDICATING CLOCKS AND PROGRAM DEVICES

- A. Description: Box and cover-plate assembly shall be furnished by device manufacturer and be suitable for device to be mounted. Back boxes shall be equipped with knockouts and hanger straps or mounting adapters arranged for flush mounting the device unless otherwise indicated.

2.08 RACK-MOUNTING PROVISION FOR MASTER CLOCK

- A. Equipment Cabinet: Floor -mounted, rack type. Comply with EIA-310-D and the following:
 1. Cabinet Housing: Constructed of steel, with front and rear doors; with manufacturer's standard tumbler locks, keyed alike.
 - a. Front door shall have a clear panel in front of the master clock display.
 - b. Housing shall enclose master clock and auxiliary clock system components, plus a minimum of 20 percent spare capacity for future equipment.
 2. Forced Ventilation: Internal low-noise fan with a filtered intake vent, connected to operate from 105- to 130-V ac, 60 Hz; separately fused and switchable and arranged to be powered when main cabinet power switch is on.
 3. Natural Ventilation: Ventilated rear and sides with louvers and solid top.
 4. Arrange inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 5. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by equipment or panels.
 6. Finish: Uniform, baked-enamel, finish over rust-inhibiting primer.
 7. Power-Control Panel: On front of equipment housing; with master power on-off switch and pilot light, and socket for a 5-A, indicating, cartridge fuse for rack equipment power.
 8. Vertical Plug Strip: Grounded receptacles, 12 inches o.c. the full height of rack, to supply rack-mounting equipment.
 9. Maintenance Receptacles: Duplex convenience outlet with supply terminals separate from equipment plug strip and located in front of rack.

2.09 CONDUCTORS AND CABLES

- A. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but not smaller than No. 22 AWG. Voltage drop for signal, control, and clock correction circuits shall not exceed 10 percent under peak load conditions.
- B. 120-V AC and Class 1 Signal and Control Circuits: Stranded, single conductors of size and type recommended by system manufacturer. Materials and installation requirements are specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 2 and Class 3 Signal and Control Circuits: Single conductor or twisted-pair cable, unshielded, unless manufacturer recommends shielded cable. Materials and installation requirements are specified in Section 260523 "Control-Voltage Electrical Power Conductors and Cables."

- D. Data Circuits: Category 6 minimum, unshielded, twisted-pair cable, unless manufacturer recommends shielded cable.
- E. Insulation: Thermoplastic, not less than 1/32 inch thick.
- F. Plenum Cable: Listed and labeled for plenum installation.
- G. Conductor Color-Coding: Uniformly identified and coordinated with wiring diagrams.
- H. Shielding: For speaker-microphone leads and at other locations recommended by manufacturer; No. 34 AWG tinned, soft-copper strands formed into a braid or equivalent foil.
 - 1. Minimum Shielding Coverage on Conductors: 60 percent.

2.10 PATHWAYS

- A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Section 270528 "Pathways for Communications Systems."
- B. Intercommunication and Program System Raceways and Boxes: Same as required for electrical branch circuits specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- C. Intercommunication and Program System Raceways and Boxes: Metal wireways.
- D. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
- E. Flexible metal conduit is prohibited.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount system components with fastening methods and devices designed to resist the seismic forces indicated in Section 270548.16 "Seismic Controls for Communications Systems."

3.02 PROJECT RECORD DOCUMENTS

- A. In addition to requirements specified in other sections, submit the following project record documents to the Architect.
- B. As-Built Drawings indicating equipment locations, wiring types, panel configurations, sizes, and a point-to-point-wiring diagram of circuits. Drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details. Drawings shall be presented in both hard copy and electronic form (.DWG format prepared using the most recent version of AutoCAD on a labeled CD-ROM prepared for use on a Windows platform. Provide one hard copy and one electronic copy. Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes bound into the manual.
- C. Test Results: Submit test results to the Architect and Merritt College.
- D. A detailed explanation of the operation of the system.
- E. Instructions for routine maintenance.
- F. Detailed instructions for repair of major components of the system.
- G. Pictorial parts list and part numbers.
- H. Pictorial and schematic electrical drawings of system, including operating and safety devices, control panels, and major components.
- I. Installation instructions for system components.

- J. Programming instructions.
- K. Program listing: Completion documentation, both electronic and bound hard copy, shall contain an index organized vertically by assembly and item number and horizontally by columns. The leftmost column shall be the item number; next shall be the description, followed by the applicable Specification section number, and followed by the specified item, which is followed by the submitted item.

3.03 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Support cables not enclosed in raceways on J-Hooks. Install, size, and space J-Hooks to comply with TIA-568-C.

3.04 ELECTRICAL CONNECTIONS

- A. Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- B. Use plug connectors for connections to clocks and signal devices.
- C. Ground clocks, programming equipment, and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.05 IDENTIFICATION

- A. Comply with Section 270553 "Identification for Communications Systems."
- B. Color-code wires, and apply wire and cable marking tape to designate wires and cables so they are uniformly identified and coordinated with wiring diagrams throughout the system.

3.06 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installation, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance. Include operation of all modes of clock correction and all programming and manually programmed signal and relay operating functions.
 - 2. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
- D. Clock system will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

3.07 ADJUSTING

- A. Program system according to Owner's requirements. Set system so signal devices operate on Owner-required schedules and are activated for durations selected by Owner. Program equipment-control output circuits to suit Owner's operating schedule for equipment controlled.
- B. Adjust sound-output level of adjustable signal devices to suit Owner's requirements.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.08 WARRANTY

- A. Manufacturer shall provide a 5 year limited warranty on system transmitters, clocks, digital timers, timer control switches, wireless tone generators, and GPS receivers.
- B. All other system components shall have a 1 year limited warranty, including external antennas and components, wireless data receivers, and universal power supply (UPS) backups.
- C. Contractor shall provide 1 year warranty on installation.
- D. Warranty begins upon system acceptance in writing by Merritt College ITS department.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain clock-and-program-control system components.

END OF SECTION

SECTION 27 5319

DISTRIBUTED ANTENNA SYSTEM (DAS)

EMERGENCY EMERGENCY RESPONDER RADIO COMMUNICATIONS SYSTEMS (ERRCS)

PART 1 - GENERAL

1.01 OVERVIEW

- A. Merritt College Child Development Center located 12500 Campus Dr. Oakland , CA 94619.
- B. The Peralta Community College District Merritt College Child Development Center (hereinafter referred to as "Owner") requests proposals for a complete design build of the Distributed Antenna System for Public Safety by qualified firms (hereinafter referred to as "DAS Contractor").
- C. This specification describes the technical and performance criteria for deploying a Distributed Antenna System (DAS) supporting Public Safety Networks (PSN) also known as Emergency Responder Radio Communications Systems (ERRCS).
- D. The DAS Contractor shall provide complete and turn key Emergency Responder Radio Communications Systems system design (including iBWave or equal modelling tool), project management, coordination with AHJ Frequencies, coordination with Owner Entities (e.g. Facilities and AHJs) and installation all required hardware, equipment, antennas, cabling, labeling, testing, configuration, programming, coordination and documentation for a complete and operable system.
- E. The DAS components specified in this document include: Donor Antennas, Coverage Antennas, , Coax Cable, Coax Connectors, Splitters, Combiners, Couplers, filters, Power Supply and Repeater and Bi-Directional Amplifiers (BDA) Units.
- F. Prices quoted shall be all-inclusive and represent a complete fully-engineered DAS Public Safety system for Emergency Responder Radio Communications Systems in compliance with latest local Authority Having Jurisdiction codes and requirements.
- G. Omissions in the proposal of any provision herein described shall not be construed as to relieve the Contractor of any responsibility or obligation requisite to the complete and satisfactory delivery, installation, operation and support of DAS Public Safety system in accordance with local Authority Having Jurisdiction (AHJs).
- H. Installation shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, and the National Electrical Contractors Association (NECA) Standard of Installation and requirements set forth by first-responder code, ordinance, or the PSN (Public Safety Network) AHJ (Authority Having Jurisdiction) including the codes: FCC CFR 90.219, ICC IFC-09, NFPA 72-07
- I. Bidder shall certify that is has been a Manufacturer-Authorized Partner for all bid systems/equipment for at least two years prior to the RFP Release Date, and that it has the certification/specialization level required by bid Manufacturer(s) to support product sale, product pricing, product installation, testing and ongoing product support in the Oakland City California geographic area in accordance with the applicable Manufacturer certification/specialization requirements.
- J. The contractor selected for this project must adhere to manufacturer specified engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.

- K. All bid products and materials shall be new, of the latest design and engineering level, are free of operational or cosmetic defects, and are delivered in their original packaging. By submitting a proposal in response to the RFP, Bidder confirms that they have sourced all products bid from Manufacturer or through Manufacturer-Authorized Channels only, in accordance with all applicable code, laws and policies at the time of purchase.
- L. Where conflicts and/or irregularities occur between specifications, applicable codes, rules, regulations, ordinances, standards, guidelines and best practices, the more code stringent requirement shall apply.
- M. All permits, licenses, applicable sales taxes, insurance requirements, payment/performance bond costs, and other miscellaneous costs are the responsibility of the Contractor and must be included in the contract price and this scope of work.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Comply with the Related Sections requirements of:
 1. Section 270526, "Grounding and Bonding for Communications Systems"
 2. Section 270529, "Hangers and Supports"
 3. Section 271100, "Communications Equipment Room Fittings"
 4. Section 271300, "Communications Backbone Cabling"
 5. Section 271500, "Communications Horizontal Cabling"
 6. Section 283111, "Digital, Addressable, Fire Alarm System"

1.03 SUMMARY

- A. This specification describes technical and performance criteria for deploying a Distributed Antenna System (DAS) capable of supporting Emergency Responder Radio Communications Systems also referred as Public Safety Networks (PSN).
- B. The DAS components specified in this document include:
 1. Bi-Directional Amplifiers (BDA),
 2. Pre-manufacture cable/remote units
 3. Donor Antennas,
 4. Coverage Antennas,
 5. Coaxial Cable and Coax Connectors
 6. Splitters, Combiners, and Couplers,

1.04 SYSTEM DESCRIPTION

- A. The in-building Radio System for ERRCS "Emergency Responder Radio Communications Systems " and/or Public Safety Network (PSN) shall reliably distribute RF signals throughout the entire building per specified AHJ frequencies and coverage requirements.
- B. The system shall include subsystems, equipment, components, transmission media, connection/ termination apparatus, etc., necessary for a complete , turn key and operating system as described herein.
- C. The PSN shall include a head end subsystem. The PSN head end shall provide common interface node to public safety / first responder equipment.
- D. The PSN system shall be supported by a UPS that provides at least 12-hours of runtime for public safety radio distribution to ensure there is no power disruption during power outage. Contractor shall provide UPS to support the public safety radio distribution.

- E. At least two independent and reliable power supplies shall be provided for all repeater, transmitter, receiver, and signal booster component. The primary power source shall be supplied from a dedicated branch circuit and comply with NFPA 72-2019. The power sources must be coordinated with electrical contractor by vendor
- F. Services: Upon system acceptance testing, the DAS shall provide coverage for the PSNs listed below

1.05 FREQUENCY RANGE: THE SYSTEM SHALL SUPPORT ALL FREQUENCIES REQUIRED BY AHJ FOR UHF^[1] , VHF 450- 520 MHZ AND THE FUTURE PLANNED 700/ 800 MHZ DEPLOYMENTS. IT IS THE CONTRACTOR’S RESPONSIBILITY TO CONTACT AHJ AND VALIDATE ALL FREQUENCIES REQUIRED PROVIDE AND INSTALL SYSTEM THAT COMPLY WITH ALL REQUIREMENTS.

^[1] Design Build Contractor shall confirm with local AHJ if UHF is required, and provide a compliant system for Oakland City .

1.06 FREQUENCY RANGE: THE SYSTEM SHALL SUPPORT ALL FREQUENCIES FOR VHF 150 MHZ, UHF 450- 520 MHZ AND THE FUTURE PLANNED 700/ 800 / 900 MHZ DEPLOYMENTS

- A. The system shall distribute RF coverage at all Merritt College Child Development center (Increment 1 and 2) including:
 - 1. Stairwells
 - 2. Elevators
- B. The system shall be DAS public safety shall be standalone system.
- C. Public Safety^{*2}

System Type	Public Safety
Public Safety LMR Paging	150 450 700 800

- D. Public safety (including “First Responder”), for the following services:
 - 1. Local PD
 - 2. City PD
 - 3. County Sheriff

^[2] The Design Build Contractor shall contact AHJ and validate all frequencies required prior responding RFP and commencing work.

- E. The system shall support multiple frequencies in a modular architecture so services can be added or removed without requiring new infrastructure, without readjustment of signal power levels, or disturbing existing services.
- F. The system shall enable frequencies to be added without requiring additional cabling or antennas.
- G. The system shall not impede any management features or functionality of any attached network and/or device management system. The system shall allow for proactive management and end-to- end alarming of active electronics. The system shall provide fault management information.
- H. The RF design, antenna placement and mounting must be coordinated with both the architect and the owner throughout the project.

- I. The DAS ERRCS headend equipment for Merritt College Child Development Center shall reside at 'IT room 113'. The Head-end equipment shall include all required local AHJ Public Safety frequencies to provide complete ERRCS systems. The Public Safety signal strength inside the building should be at least -95 dBm over 95% of the coverage area. Contractor shall validate frequency requirements with AHJ prior commencing work.. The roof penetration shall be provided by General Contractor .
- J. Emergency Responder:
 - 1. The system shall interface with Fire Alarm System signaling meeting compliance with NFPA- 72.
 - 2. The System shall monitor the power source, system status, and other critical aspects to the System's overall operation and shall provide alarming annunciation – all as required by the AHJ.
 - 3. The System shall distribute public safety duplex and simplex channels to -75 dBm (or stronger) signal strength throughout 95% of all occupied building spaces and 99% in critical areas as defined in NFPA 72 or as specified by local ordinance and agencies. Public safety includes campus, local and city police, county sheriff, and fire departments. Confirm with AHJ, owner and any additional authority the frequencies that will be in use at the time of facility opening.
 - 4. PIM level of -160 dBc or better on all segments
- K. PSN Approval: The Contractor shall propose and deploy a DAS system capable of receiving approval of the PSN Authority Having Jurisdiction (AHJ).
- L. Network Management:
 - 1. NMS: The DAS shall have a Network Management System (NMS) capable of alarm, monitor, configuration and control of all Active Components.
- M. Supervision and Monitoring:
 - 1. The DAS Electronics shall provide the following outputs for monitoring by the Fire Alarm System:
 - a. Donor Antenna Malfunction
 - b. Signal booster Failure
 - c. Signal Booster Trouble.
 - d. Loss of AC Power
- N. Base Bid Work
 - 1. Includes design, furnishing materials, installation, predictive RF map and coordination through the General Contractor with other trades for a complete, operational, and balanced system. Furnish necessary materials, accessories, fasteners, etc., and the labor and associated services required to provide the system specified herein.
 - 2. The work of this section includes the following (described in greater detail in Part 3):
 - a. Project management services
 - b. Produce a permit package, licensed engineer stamp, permit fees, review and approval process
 - c. Validate first responder frequencies with appropriate entities such as local fire, police, sheriff
 - d. Antenna placement and mounting coordination with both architect and owner
 - e. Detailed system design including equipment locations, RF propagation map
 - f. Installation and system balancing
 - g. Coordination with the overall construction team and usage of pathways provided by others
 - h. Manage FCC Licensing
 - i. Manage all FCC registration including Part 90 requirements
 - j. System acceptance testing and turn over to owner
 - 3. The work of this section requires particular attention to the following:

- a. Ceiling Types: The installer shall fully understand every ceiling type and its interaction with the system. For example, some ceiling types may impede RF signals and, subsequently, system performance.
 - b. Mounting details: the installer shall coordinate mounting of antenna and the RF impact. It may be preferred that antenna be mounted above or below ceiling grid. Coordination with both architect and owner is required.
 - c. Pathways: The work of this section requires the installer fully understand the pathways and to coordinate placement of cables within those pathways.
 - d. Maintenance Contract for support services for 12-months from the completion of the project.
- O. Work Covered Under Other Sections
- 1. Pathways – backbone conduits and primary pathways
 - 2. Telecommunications Rooms – equipment support (racks), power, cooling, and grounding
 - 3. Wired network

1.07 PERFORMANCE REQUIREMENTS

- A. PUBLIC SAFETY NETWORK (PSN) DAS:
- 1. The PSN DAS shall comply with IFC 510 2018 edition and NFPA-72 2019 Edition (latest edition).
 - 2. Where the in-building coverage requirements include 700 - 800 MHz public safety system and commercial wireless in-building coverage, the two systems shall operate over a unified Passive Cable and Coverage Antenna Infrastructure.
 - 3. The DAS shall deliver coverage per the criteria in Table 1 throughout 95% of all occupied building spaces and 99% in critical areas as defined in NFPA 72.

TABLE 1 SYSTEM PARAMETERS PSN

Parameters	Units	Public Safety 380-512, 700, 800 MHz
Minimum Downlink RSSI	dBm	-95

- 4. The DAS shall be capable of upgrade, without additional hardware or software, to allow for changes to system frequencies within the deployed frequency band in order to maintain radio system coverage as originally designed.
- B. Submittal Requirements with the Bid:
- 1. Contractor shall provide a complete submittal, partial submittals will not be reviewed, submittal shall include all cutsheets of all products associated with the scope of work. Exact part numbers shall be clearly identified in the submittals.
 - 2. Product Data: Submit manufacturer datasheets for the following components:
 - a. Donor and Coverage Antennas
 - b. Coaxial Cable and Connectors
 - c. Splitters, Combiners and Couplers
 - d. Bi-Directional Amplifiers (BDA)
 - e. All active components and power requirements
 - f. Bill-of-Material (BOM)
 - g. Predictive RF map
 - 3. Certificates
 - a. A certificate from the manufacturer of the equipment to be installed stating that the DAS installer is trained/ qualified on the equipment.
 - b. iBWAVE Software Certifications (or approve equal RF modeling tool)
 - 4. Test Equipment
 - a. Submit certificates indicating that staff is certified on required test equipment including by not necessarily limited to:

- 1) Signal Generators
 - 2) Spectrum Analyzers
 - 3) Pim Testers
 - b. Submit current calibration data for test equipment to be used.
- 5. Bid Assumptions
 - a. Contractors shall state the assumed channel count for the PSN Frequency Bands identified above with submittal of bid response. Prior to installation, contractors shall confirm the channel count and frequencies with the AHJ, and guarantee coverage for these channels per the criteria stated above.
- C. Submittal Requirements Prior to Start of Construction
 - 1. Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer's designated representative.
 - 2. Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer's designated representative.
 - 3. To scale floor plans showing the location of system Components.
 - 4. Final RF link budget
 - 5. Detail Drawings for Donor Antenna and grounding
 - 6. RF propagation modeling (Heat maps)
 - 7. Product Data Sheets for each type of equipment to be installed.
 - 8. Maintenance Service Contract
 - 9. Permit drawings as required by the AHJ.
- D. Submittal Requirements at Close Out
 - 1. Drawings: Submit as-built drawings indicating:
 - a. Donor antenna, grounding and lightning protection details
 - b. Cable routing, splitters, couplers and coverage antenna locations
 - c. Active component locations, layout and configuration
 - 2. Test Reports
 - a. PSN: Submit Accepted ATP reports confirming the requirements of Section 1.4 have been met.
 - 3. Cable Test Reports: Submit cable test results for all cable segments. Testing shall include Return Loss (RL), Distance to Fault (DTF) and Passive Intermodulation (PIM).
 - 4. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
 - 5. Acceptance Certificate
 - 6. Warranty Documents:
 - a. Submit for all manufactured components specified in this Section.
 - b. Submit Contractor's System Warranty.
 - c. Submit Manufacturer's Extended Warranty

1.08 SUBSTITUTIONS

- A. Acceptance of substitute equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, that meets or exceed the performance as stated or implied in the Contract Documents. Proposed solution must comply with all requirements from local AHJ for a fully functional and turn key system.
- B. Submit proposals to provide substitute materials or equipment, in writing, in compliance with Bidding and Division 1 requirements. Reimburse Owner for costs associated with the review of the proposed substitution whether substitution is accepted or rejected.
- C. Indicate revisions required to adapt substitutions including revisions by other trades. Substitutions that increase the cost of the work for related trades are not permitted.

- D. The proposed substitution shall conform with ratings, and operating characteristics of the equipment or systems as specified and shown on the Drawings.
- E. Proposals for substitutions shall include the following information:
 - 1. Passive Components:
 - a. Product samples
 - b. Detailed product specifications
 - c. Independent test results verifying the product specifications
 - 2. Active Components:
 - a. Hardware and software manuals
 - b. Detailed product specifications
 - c. Mean Time Between Failure (MTBF) data for each Active Component

1.09 CODES AND STANDARDS

- A. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing **shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation.** In case of discrepancy or disagreement between the documents noted above, the contractor shall satisfy the most stringent requirements. Equipment and cabling installation shall comply with the following standards. All publications must be of the latest issue and addenda:
 - 1. NFPA 70 - 2011 National Electrical Code (NEC®)
 - 2. California Code of Regulations (CCR), Title 24, Part 9, "California Fire Code", Appendix J, 2019 edition
 - 3. International Fire Code (IFC), 2018 edition, section 510
 - 4. 2009 (2018) International Fire Code
 - 5. NFPA 72 2019 – National Fire Alarm and Signalling Code:
 - a. Part 24.5.2.1 to 24.5.2.7 Two-Way Radio Communication Enhancement systems
 - b. Part 24.3.5 to 24.3.6.8.4 Pathway Survivability
 - c. Part 10.6.5.1 Branch Circuit
 - d. Part 10.6.9 Monitoring Integrity of Power Supplies
 - e. Part 10.6.10 Storage Batteries
 - f. Part 10.6.11 Engine Driven Generators
 - g. Part 14.4.12.1 to 14.4.12.1.6 In-Building Emergency Radio Communication systems
 - 6. Federal Communications Commission (FCC) :
 - a. Title 47 of the Code of Federal Regulations, Part 90.
 - b. Part 24: Personal Communications Server
 - c. Part 27: Miscellaneous Wireless Communications Services
 - d. Part 90: Specialized Mobile Radio Service
 - e. Part 95: Personal Radio Services Rules
 - 7. Federal Communications Commission (FCC) Rules, Parts 15 and 22
 - 8. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces (May 2009)
 - 9. ANSI/TIA-606-B: The Administration Standard for the Telecommunications Infrastructure of Commercial Building (June 2012)
 - 10. ANSI/ TIA-J-STD-607-B: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (April 2012)
 - 11. BICSI Information Transport Systems Installation Methods Manual, 6th Edition
 - 12. BICSI Telecommunications Distribution Methods Manual, 13th Edition
 - 13. It is the Contractor's responsibility to ensure that the DAS complies with local code, ordinances or requirements established by the PSN AHJ.

1.10 ABBREVIATIONS

ACG: Automatic Gain Control
AHJ: Authority Having Jurisdiction
ATP: Acceptance Test Plan
AWS: Advanced Wireless Service
BDA: Bi-Direction Amplifier
BOM: Bill-of-Material
CDMA: Code Division Multiple Access
C/N: Carrier-to-Noise Ratio
CW: Continuous Wave
CWDM: Coarse Wave Division Multiplexing
DAS: Distributed Antenna System
DWDM: Dense Wave Division Multiplexing
EBS: Educational Broadband Service
ESMR: Enhanced Specialized Mobile Radio
FCC: Federal Communications Commission
GROL: General Radio Operators Licence
GUI: Graphical User Interface
iDEN: Integrated Enhanced Digital Network
LMR: Land Mobile Radio
LTE: Long Term Evolution
MIMO: Multiple Input, Multiple Output
MTBF: Mean Time Between Failure
NFPA: National Fire Protection Association
NMS: Network Management System
PCS: Personal Communications System
PSN: Public Safety Network
RoF: Radio-over-Fiber
RoHS: Restriction of Hazardous Substances
RSSI: Received Signal Strength Indication
SISO: Single-Input, Single-Output
SMR: Specialized Mobile Radio
SMS: Short Message Service
SNIR: Signal-to-Noise Interference Ratio
SNMP: Simple Network Management Protocol
SOW: Statement of Work

VSWR: Voltage Standing Wave Ratio

1.11 DEFINITIONS

- A. Acceptance: Expressed approval by the customer
- B. Active: DAS components that require AC/DC power for operation
- C. Carrier Approval: Expressed approval to interconnect to the WSP macro network
- D. Channel: A path for an RF transmission between two points
- E. Component: A main system element of the DAS
- F. Contractor: The prime contractor bidding the project
- G. Passive: DAS components that do not require AC/DC power for operation

1.12 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Obtain equipment from a single manufacturer.
 - 2. Contractor must have an office within 100miles of the project site.
 - 3. Contractor or systems integration partner shall have the following major components in stock:
 - a. (1) 700/800 or 450 MHz BDA
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. The work specified in this Section is acknowledged to require special skills mastered by education, experience, or both. Bidders for work described in this Section shall be or shall subcontract with established DAS/RF communications contractors. The contractor shall have direct access to all tools and test equipment required to complete the work prior to submitting a bid.
- D. Requirements set forth by first-responder code, ordinance, or the PSN AHJ shall supersede the requirements described herein and shall be met in their entirety. It is the Contractor’s responsibility to ensure that the DAS complies with local code, ordinances or requirements established by the PSN AHJ.
- E. PSN Approval
 - 1. When approval of the DAS deployment is required by code or ordinance, the Contractor shall be responsible for facilitating the AHJ approval(s) per the requirements of the code or ordinance.

1.13 WARRANTY

- A. Manufacturer Warranty:
 - 1. Splitters, Couplers and Coverage Antennas: 5-year limited warranty from date of system acceptance.
 - 2. Coaxial Cable and Connectors: 10-year limited warranty from date of system acceptance.
 - 3. Active Components: The earliest of 1-year limited warranty from date of system installation or 15 months from date of shipment.

1.14 MAINTENANCE

- A. The Contractor shall provide a maintenance service contract, covering the system for a period of one-year with options up to five years: preventative maintenance, system monitoring, fault mitigation, equipment repair, and response time.

- B. Annual Testing
 - 1. As required by Code, the system shall be tested annually beginning one (1) year from the date of final acceptance testing. The contractor or systems integrator shall provide a price for an additional service contract to include the required annual testing as described in part 3 below.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements provide products by one of the following:
 - 1. FLEX
 - 2. Westell
 - 3. Comba
 - 4. Or approved equal
- B. ERRCS Components ^[3]:
 - 1. Donor Antennas (mounted on the rooftop)
 - 2. Indoor Antennas disperse throughout the building to meet AHJ coverage requirement.
 - 3. Filter
 - 4. Power Supply – for 12-hour back-up
 - 5. Repeater
 - 6. Splitter
 - 7. All necessary cables for a complete turn-key solution
 - 8. Connector
 - 9. Micellaneous : monitoring equipment and any other apparatus required for fully compliant and operational system

[3] The design build contractor shall provide DAS ERRCS design to meet all requirements set forth in this specifications and by local ahj and provide complete build of materials for turnkey DAS ERRCS system. components listed are to convey design intent , and shall not be interpreted as bill of materials.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The contractor and/ or Systems Integrator shall design, install, commission and test the DAS in accordance with the manufacturer’s instructions and recommendations.
- B. Extend cabling from the enclosures to the splitters in a neat and orderly manner per the routing indicated on the contract drawings. Support cabling in compliance with NEC chapter 8 requirements and manufacturers recommendations.
- C. Maintain a 6” minimum distance from the DAS cabling and other cabling for parallel runs. Do not install coaxial cabling open in any areas were the cabling will subject to physical damage.

3.02 EQUIPMENT MOUNTING

- A. Install wall mounted Enclosures in equipment spaces as indicated on plans in accordance with manufacturers instructions and seismic requirements.
- B. Install Headend equipment in telecom room as indicated on the drawings. Fasten to the floor/wall per manufacturers instructions and provide seismic bracing if required in compliance with local codes.

- C. Contractor shall provide location and mounting of all antennas to the design team to review and approval prior to installation .

3.03 COORDINATION WITH OTHER TRADES

- A. Field coordinate the installation of the headend equipment and remotes to ensure that each location is provided with the following:
 - 1. a 120V, 20A circuit
 - 2. Grounding per NEC and TIA standards.
 - 3. Coordinate Alarm and Monitoring points with the Fire Alarm contractor.

3.04 EXAMINATION

- A. The contractor must examine areas and conditions under which DAS components are to be installed and notify the owner's representative, in writing of those conditions which are, in the Contractor's opinion, potentially detrimental to proper completion of the work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the owner.
- B. Examine pathway elements intended for cable, check raceways, cable trays and other elements for compliance with space allocations, installations tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Specific items of examination shall include, but shall not necessarily be limited to, the following:
 - a. Locations for all new DAS antennas, cable and splitter equipment.
 - b. The Contractor shall examine all rooms designated to house DAS equipment to ensure adequate space, power, and environment conditions to support installation.

3.05 TESTING

- A. Acceptance testing shall be performed confirming the requirements have been met.
- B. The contractor shall complete the acceptance testing as prescribed in the approved Acceptance Test Plan (ATP) submittal. The DAS system shall be tested by a person or persons who are holders of a FCC General Radio Operator's License (GROL) or by the AHJ or his/ her designees.
- C. Testing Procedure (PSN):
 - 1. Test Location
 - a. Each floor of the building shall be divided into a grid of 20 approximately equal test areas.
 - b. Downlink received signal level measurements shall be recorded in the coverage area using a CW test signal. Measurements shall be collected using a spectrum analyzer and a dipole antenna.
 - c. Failure of a maximum of two nonadjacent test areas shall not result in failure of the test.
 - d. In the event that three of the test area fail the test, in order to be more statistically accurate, the floor shall be divided into 40 equal equal test areas. Failure of a maximum of 4our non adjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 90% coverage.
 - e. A test location approximately in the center of each test area shall be selected for the test. Once the location has been selected, the location shall represent the entire test area.
 - 2. Equipment Requirements
 - a. Test equipment shall be allowed to stabilize in test environment prior to calibration for a minimum of thirty minutes. Any change in temperature can void the calibration.

- b. Signal generator must be connected to the Head end downlink (TX) interface via tested and approved coaxial cabling and connectors.
 - c. Signal generator transmits frequency (MHz) and Power (dBm) must be preapproved by project engineer prior to testing. The control channel from the base station can be used as a signal source as well.
 - d. Verify that all remote units for the area under test are ON.
 - e. Test frequency and power must be recorded corresponding to the date and time of each site walk measurement.
 - f. Spectrum analyzer with unity gain (0dB, frequency specific) dipole receive antenna must be preapproved by the project engineer.
 - g. Site walk screen shots shall be saved with frequency span +/- 20 MHz relative to the center/measured frequency.
3. Documentation
- a. Exact location of measurement must be marked on the grid print.
 - b. Screen shots must be taken in all designated grid spaces. If more than one reading is saved per grid zone, saved results shall be distinguished from one another using Grid##"A", Grid## "B" etc.
 - c. Results of testing are reported to project engineer for analysis and reporting.
- D. Proof of Performance and Testing Methodology:
- 1. Test requirements specified in this document shall be successfully completed prior to issuance of a Certificate of Occupancy and yearly thereafter. Also testing with a successful result shall occur whenever a design change is made to the system, which changes the technical performance or coverage of the system. All tests shall be coordinated 10 days in advance with the AHJ. Results of the test shall be reported in writing to the AHJ.
- E. Technical training
- 1. The Contractor shall be responsible for organizing a structured demonstration of acceptance tests to ensure organized and efficient testing.
 - 2. The Contractor shall provide written notice to the owner's representative at least thirty (30) calendar days in advance of the initiation of final system acceptance testing. Included in the advance notice shall be three (3) copies of the approved test plans and procedures to ensure acceptance test monitoring personnel are familiar with the tests, procedures and the expected results.
 - 3. It is the responsibility of the Contractor to notify the owner's representative at appropriate times to permit visual inspections of all DAS components. No Installation work shall be covered until a visual inspection has been completed.
 - 4. Provide the owner's representative with the opportunity to witness all testing. On reasonable request and with ten (10) working days' notice, the Contractor shall demonstrate that the test procedure competently identifies the parameter being demonstrated or the fault condition being tested.
 - 5. The Contractor shall provide a Certificate of Compliance signed by a responsible company representative after completion of the site installation. This document shall certify that each element of the installed system and wiring complies with the requirements of the Contract Documents and the certification shall be included with the final acceptance report.
 - 6. The Contractor shall provide training for elements of the DAS. Such training shall include management, operational and maintenance levels and shall be provided to individuals (maximum of 3) to be designated by the owner's representative.
 - 7. Training shall be conducted by qualified personnel fully conversant on the equipment, materials, software, and over all operation of the installed elements. Training shall be based upon as much hands-on training as is possible. The Contractor shall provide all necessary training aids and materials, which shall include written handouts.
 - 8. All training shall be completed prior to Final Acceptance.

3.06 TRAINING

1. Retain the Systems Integrator to instruct the Owner/ Owners Maintenance Personnel on the proper operation of the system including alarms.
2. Provide time for 1 training session for one hour.
3. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

**SECTION 31 1000
SITE CLEARING**

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Removing existing trees and other vegetation.
 - 2. Removing above- and below-grade site improvements.
 - 3. Disconnecting and capping or sealing site utilities.
 - 4. Temporary erosion and sedimentation control measures.

1.02 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site and disposed of properly.
- B. Historic items, relics, and other items of interest or value to the Owner encountered during site clearing shall remain the Owner's property. Contact Architect for direction without moving objects.

1.03 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify public utility locator service for area where Project is located a minimum of 48 hours prior to site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings and the requirements of authorities having jurisdiction.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.]

3.03 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.04 UTILITIES

- A. Locate, identify, disconnect, and seal or cap-off utilities indicated to be abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Utilities 8 inches in diameter or less indicated to be demolished may be plugged and abandoned in place, except under proposed building footprints.

3. Utilities 10 inches in diameter or greater indicated to be demolished shall be removed or abandoned in place by filling with lean concrete, except under proposed building footprints.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.

3.05 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving curbs, and gutters at existing full-depth joints unless indicated otherwise. Neatly saw-cut length of existing pavement to remain with vertical faces prior to removing existing pavement.

3.06 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

**SECTION 31 1413
TOPSOIL STRIPPING AND STOCKPILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Salvaging and stockpiling topsoil

1.02 RELATED SECTIONS

- A. Section 01 5639 – Temporary Tree and Plant Protection
- B. Section 31 1000 – Site Clearing
- C. Section 31 2000 – Earth Moving
- D. Section 32 9110 – Topsoil

1.03 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction.

1.04 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.

1.05 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 32 9110 Topsoil. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 5639 Temporary Tree and Plant Protection.
- C. Protect existing site improvements to remain from damage during construction.
- D. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TOPSOIL STRIPPING

- A. Remove shrubs, sod, and grass before stripping topsoil.
- B. Use of chemicals and pesticides shall not be allowed.
- C. Topsoil within the limits of the project shall be salvaged prior to beginning excavating, fill or hauling, operations.
- D. Strip topsoil to 2-3" depth in a manner to prevent intermingling with underlying subsoil or other waste materials. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- E. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover stockpiles to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within tree protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.
- F. Salvaged topsoil exceeding the quantity required under the contract shall be disposed of at contractor's expense.

3.03 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

**SECTION 31 2000
EARTH MOVING**

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Excavating and backfilling for utility trenches.
 - 4. Base course for concrete walks and pavements.
 - 5. Base course for asphalt paving.

1.02 SUBMITTALS

- A. Product Data: All soil materials. Include technical data and tested physical and performance properties.

1.03 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between subgrade and hot-mix asphalt or concrete paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades.

- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Site Information: Research public utility records and verify existing utility locations prior to ordering any material. Notify the Architect immediately if any discrepancies are found in the project survey.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Imported soil that is free of organic matter, contain no rocks or lumps larger than three inches in greatest dimension, have a liquid limit less than 40 and plasticity index less than 12, and be approved by the Geotechnical Engineer.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Base Course: California Standard Specifications, Class 2 Aggregate Base for 3/4-inch aggregate. Aggregate may include up to 50 percent reclaimed material by volume.
- E. Engineered Fill: See Satisfactory Soils.
- F. Bedding Course: California Standard Specifications, Class 2 Aggregate Base for 3/4-inch aggregate. Aggregate may include up to 50 percent reclaimed material by volume.
- G. Bioretention Soil Media: Mixture of 60%-70% fine sand and 30%-40% compost, measured on a volume basis, and achieving a long-term, in-place infiltration rate of at least 5 inches per hour.
 - 1. Sand for Bioretention Soil:

- a. Sand shall be free of wood, waste, coating such as lca, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing No. 200 sieve size shall be nonplastic.
- b. Sand for bioretention soil shall be analyzed by an accredited lab using #200, #100, #40, #30, #16, #8, #4, and 3/8 inch sieves (ASTM D 422), and meet the following grading:

Sieve Size	% Passing Min (by Wt.)	% Passing Max (by Wt.)
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

- c. Composted Material: Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program.
- d. Compost Quality Analysis: Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the USCC Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Evaluate of Composting and Compost (TMECC). The lab report shall verify:
- e. Feedstock materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
- f. Organic Matter Content: 35% - 75% by dry wt.
- g. Carbon and Nitrogen Ratio: C:N < 25:1 and C:N > 15:1
- h. Maturity/Stability: Compost shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120°F) upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicate stability:
 - 1) Oxygen Test < 1.3 O₂ / unit TS / hr
 - 2) Specific oxy. Test < 1.5 O₂ / unit BVS / hr
 - 3) Respiration Test < 8 C / unit VS / day
 - 4) Dewar test < 20°C Temp rise
 - 5) Solvita® > 5 Index value
- i. Toxicity: any one of the following measures is sufficient to indicate non-toxicity.
 - 1) NH₄ : NO₃-N < 3
 - 2) Ammonium < 500 pm, dry basis
 - 3) Seed Germination > 80% of control
 - 4) Plant Trials > 80% of control
 - 5) Solvita® > 5 Index value
- j. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
 - 1) Total Nitrogen content 0.9% above or preferred.
 - 2) Boron: Total shall be <80ppm; Soluble shall be <2.5ppm
- k. Salinity: Must be reported, < 6.0 mmhos/cm

- l. pH shall be between 6.5 and 8.0. May vary with plant species.
- m. Compost for Bioretention Soil Texture: Compost for bioretention soils shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves (ASTM D 422), and meet the following gradation:

Sieve Size	% Passing Min (by Wt.)	% Passing Max (by Wt.)
1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	2	10

- n. Bulk density shall be between 500 and 100 dry lbs/c.y.
 - o. Moisture content shall be between 30% - 55% of dry solids.
 - p. Inerts: Compost shall be relatively free of inert ingredients, including glass, plastic, and paper, <1% by weight or volume.
 - q. Weed seed/pathogen destruction: Provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55°C for 15 days with at least 5 turnings during that period.
 - r. Select Pathogens: Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.
 - s. Tract Contaminant Metals (Lead Mercury, Etc.): Product must meet USA EPA, 40 CFR 503 regulations.
 - t. Compost Testing: The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.
- H. Reservoir Course: California Standard Specifications, Class 2, Type A Permeable Material.
- I. Drainage Course: California Standard Specifications, Class 2, Type A Permeable Material.
- J. Backfill and Fill:
- 1. Satisfactory soil materials.
 - 2. Initial Trench Backfill: California Standard Specifications, Class 2 Aggregate Base for 3/4-inch aggregate. Aggregate may include up to 50 percent reclaimed material by volume.
 - 3. Final Trench Backfill: Engineered Fill.
- K. In-Water Fill Material: Natural or artificially well graded angular rock with nominal maximum size of a 6 inches and having less than 5 percent passing the a 1/4- inch sieve.
- L. Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyesters, nylons, polypropylenes, or a combination thereof; per Caltrans Standard Specifications, Section 88-1.03 for underdrains.
- M. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
- 1. Grab Tensile Strength: 200 lbf; ASTM D 4632.
 - 2. Tear Strength: 75 lbf; ASTM D 4533.
 - 3. Puncture Resistance: 90 lbf; ASTM D 4833.

4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D 4491.
- N. Impermeable Liner: Medium or high density polyethylene geomembrane, ultraviolet resistant, specifically manufactured as an impermeable lining material, with the minimum properties as follows:
1. Density: 58 lb/cu. Ft; ASTM D1505.
 2. Thickness: 40 mil; ASTM D1593.
 3. Tear Strength: 42 lb; ASTM D1004.
 4. Puncture Resistant: 108 lb; ASTM 4833.
 5. Carbon Black: Not less than 2 percent; ASTM D1603.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, freezing temperatures or frost, and other hazards created by earthwork operations. Provide protective insulating materials as necessary.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 31 10 00 "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls during earthwork operations.
- D. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- E. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

3.02 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.03 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 2. Earth excavation includes excavating pavements and obstructions visible on the surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

3.04 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.05 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.06 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. Excavate trenches 3 inches deeper than elevation to allow for bedding course. Hand excavate for bell of pipes.
 - 2. Excavate utility structures to provide 9 inches clearance (enlarge as needed) to allow for compaction of backfill material.

3.07 SUBGRADE INSPECTION

- A. Proof-roll subgrade before filling or placing aggregate with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.08 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.09 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of trees to be protected.

3.10 BACKFILLS AND FILLS

- A. Backfill: Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.
 3. Inspecting and testing underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."
- D. Place and compact initial trench backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
 - 6. Under and around utility structures, use engineered fill.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to at least 4 percent above optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under mat slab, scarify, lime treat, and recompact top 18 inches of existing subgrade and each layer of backfill or fill soil material at 87 to 92 percent.
 - 2. Under walkways, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact compact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1/2-inch.
 3. Pavements: Plus or minus 1/2-inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2-inch when tested with a 10-foot straightedge.

3.16 BASE COURSE

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
1. Shape base course to required crown elevations and cross-slope grades.
 2. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of density according to ASTM D 1557.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 square feet or less of paved area or building slab, but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

**SECTION 32 1216
ASPHALT PAVING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Hot-mix asphalt paving.
 - 2. Hot-mix asphalt patching.
 - 3. Pavement-marking paint.

- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: Certification of conformance for each job mix proposed for the Work.

- B. Material Certificates: For each paving material, from manufacturer.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or Caltrans.

- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Section 39 of the 2015 Caltrans Standard Specifications for asphalt paving work.
 - 1. Measurement and payment provisions and safety program submittals included in the Caltrans Standard Specifications do not apply to this Section.

1.04 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Tack Coat: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Base Course: Minimum surface temperature of 60 deg F and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 AGGREGATES

- A. Conform to requirements of Section 39-2-02 Type “B” Aggregate of the 2015 Caltrans Standard Specifications for Construction.

2.02 ASPHALT MATERIALS

- A. Asphalt Binder: Conform to requirements of Section 92 Grade 64-10 of the 2015 Caltrans Standard Specifications.
- B. Tack Coat: Conform to requirements of Section 94 “Asphaltic Emulsions” of the 2015 Caltrans Standard Specifications.

2.03 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes conforming to Section 39 of the 2015 Caltrans Standard Specifications.
 - 2. Surface Course: Section 39 Type “A” of the Caltrans Standard Specification.
 - 3. Include a minimum of 15% Recycled Asphalt Pavement (RAP) in mix design.

2.04 AUXILIARY MATERIALS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate-free, ready mixed, complying with FS-TT-P-1952D, with drying time of less than 15 minutes.
 - 1. Color: White and Yellow: Caltrans Spec. No. 8010-20B
Blue: Federal Standard 595b, Color No. 35180
- B. Glass Beads: AASHTO M 247, Type 1.
- C. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, a maximum of 5.25 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 3/4-inch diameter, 18-inch minimum embedment length.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Saw-cut excavation faces vertically.

Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.03 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.04 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Spread mix at minimum temperature of 250 deg F.
 - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.05 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.06 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.07 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.08 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 30 days before starting pavement marking.

- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 5 mils.
 - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.09 WHEEL STOPS

- A. Install wheel stops in bed of adhesive as recommended by manufacturer.
- B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Replace and compact hot-mix asphalt where core tests were taken.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 DISPOSAL

- A. Excavated materials from the Project site to be recycled on-site to the extent practical. Excess excavated materials from Project site shall be legally disposed of off-site.

END OF SECTION

SECTION 32 1313

SITE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall provide all materials, equipment and labor necessary to furnish and place ready-mix cast-in-place concrete, and shall form, mix, place, consolidate, finish, cure, repair and perform all appurtenant work necessary to produce finished concrete complete in place as shown on the Drawings and as specified herein.
- B. This Section includes the following as indicated on the Landscape drawings:
 - 1. Final subgrade preparation and paving base.
 - 2. Concrete walks, pedestrian paving, steps, ramps, seat walls, landscape retaining walls, mowing edges, bands, and curbing.
 - 3. Colored concrete finished walks and paving.
- C. Related Sections:
 - 1. Section 31 2000 – Earth Moving

1.2 REFERENCES AND STANDARDS

- A. Federal Specifications and Standards:
 - 1. PS 1 U.S.Product Standard for Concrete Forms, Class I.
 - 2. PS 20 U.S. Product Standard for American Softwood Lumber.
 - 3. UU-B-790A Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water (Int. Amd.) Repellant and Fire Resistant).
- B. State of California (Caltrans) Standards:
- C. Americans with Disabilities Act and ADA
 - 1. Accessibilities Guidelines (ADAAG) Appendix A of 28 CFR Part 35, Title II.
- D. Commercial Standards:
 - 1. ACI 301 Specifications for Structural Concrete for Buildings.
 - 2. ACI 304 Recommended Practice for Measuring, Mixing and Placing Concrete.
 - 3. ACI 305 Recommended Practice for Hot Weather Concreting.
 - 4. ACI 306 Recommended Practice for Cold Weather Concreting.
 - 5. ACI 308 Recommended Practice for Curing Concrete.
 - 6. ACI 315 Details and Detailing of Concrete Reinforcement.
 - 7. ACI 318 Building Code Requirements for Structural Concrete and Commentary.
 - 8. ACI 347 Recommended Practice for Concrete Formwork.
 - 9. ASTM A 185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 10. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 11. ASTM C 31 Practice for Making and Curing Concrete Test Specimens in the Field.
 - 12. ASTM C 33 Specification for Concrete Aggregates.
 - 13. ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 14. ASTM C 94 Specification for Ready-Mixed Concrete.
 - 15. ASTM C 143 Test Method for Slump of Hydraulic Cement Concrete.
 - 16. ASTM C 150 Specification for Portland Cement.
 - 17. ASTM C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 18. ASTM C 494 Specification for Chemical Admixtures for Concrete.

18. ASTM C 1077 Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
19. ASTM D 1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
20. AWS D1.4 Structural Welding Code - Reinforcing Steel.
21. CRSI MSP-1 Concrete Reinforcing Steel Institute Manual of Standard Practice.
22. CBC California Building Code.

1.3 QUALITY ASSURANCE

- A. All site concrete work shall comply with these specifications and all applicable sections of the above named References and Standards.
- B. Design Criteria:
 1. Concrete: ACI 301, Chapter 3.
 2. The contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances shown on the Drawing and as specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Permissible deviations for cast-in-place concrete structures shall not exceed + 1/4-inch.
- C. Record of Work: Maintain field records of time, date of placing, curing, and removal of forms of concrete in each portion of work. Such record shall be available to the Architect for examination at any time.
- D. Sample Panels: Before installing concrete work, provide sample panels, of all specified finishes, minimum 3 feet x 3 feet, using specified materials. Show color, texture, pattern, edging, and joint treatments. Correct and rebuild sample panels until Architect's acceptance of the work. Retain panels during construction as a standard for completed concrete paving work.
- E. Do not change source or brands of cement and aggregate materials during the course of the work.
- F. Concrete finisher shall have a minimum 3 years' experience finishing high-volume fly ash concrete.
- G. Slip Resistance: Concrete walk surfaces shall have a minimum wet and dry coefficient friction of 0.65 when tested in accordance with ASTM C1028.

1.4 SUBMITTALS

- A. Certificate of Compliance: Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.
- B. Mix Designs: Submit concrete mix designs for each required concrete type. Obtain the Architect's written approval before placing concrete.
- C. Reinforcement Shop Drawings: Indicate bar sizes, spacing, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules and supporting and spacing devices.
- D. Product data:
 1. Submit complete materials list of items proposed for the work. Identify materials source.
 - a. Submit documentation of recycled content for products with specified recycled content.
 2. Submit admixture, curing compound, retarder, and accessory item product data.
 3. Submit material certificates for aggregates, reinforcing, joint fillers and sealants.
 - a. Submit documentation of recycled content for products with specified recycled content.
- E. Submit concrete delivery tickets. Show the following:
 1. Batch number.
 2. Mix by class or sack content with maximum size aggregate.
 3. Admixtures.

4. Air content.
5. Slump.
6. Time of loading.

- F. Submit concrete test reports.
- G. Submit minimum 8" x 8" colored concrete samples utilizing cement and aggregate proposed for the work.
- H. Sealants: Submit samples and test data demonstrating that the proposed sealants will adhere to the surfaces to which they will be applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Reinforcing: Unload and store on timber skids and keep free of mud.
- B. Concrete
 1. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator or other transportation device within 1 1/2 hours, or 300 revolutions of the drum after mixing water has been added, whichever is greater.
- C. Store decorative exposed aggregates in segregated area to prevent mixing with foreign materials.
- D. Deliver curing materials, admixtures, and retarders in manufacturer's standard unopened containers with labels legible and intact. Store and protect from freezing and damage.

1.6 PROJECT CONDITIONS

- A. Work notification: Notify Architect at least 24 hours prior to installation of concrete.
- B. Establish and maintain required lines and grade elevations. Refer to notes on the grading plans and Section covering site grading and/or earth moving
- C. Environmental Requirements
 1. Cold Weather Placement: When depositing concrete when the mean daily temperatures are below 40 degrees F., comply with recommendations in ACI 306. Maintain concrete temperature at a minimum of 55 degrees F. for sections having a minimum dimension of less than 12 inches, or 50 degrees F. for sections having a minimum dimension of 12 inches or greater, for not less than 72 hours after depositing. The specified non-chloride accelerator or high early strength Type III cement may be used when approved by the Architect. Do not place concrete on days when the temperature at 9:00 a.m. is below 30 degrees F.
 2. Hot Weather Placement: When depositing concrete in hot weather, follow the recommendations in ACI 305. The temperature of concrete at time of placement shall not exceed 90 degrees F. Protect to prevent rapid drying.
- D. Do not install concrete work over wet, saturated, muddy, or frozen subgrade.
- E. Protect adjacent work.
- F. Provide temporary barricades and warning lights as required for protection of project work and public safety.

1.7 GEOTECHNICAL ENGINEER

- A. The Engineer will inspect subgrade and aggregate base prior to installation of concrete work.

1.8 LAYOUT OF THE WORK

- A. A licensed surveyor or registered civil engineer shall lay out and establish all lines, levels, grades and positions of all parts of the work.

PART 2 - PRODUCTS

2.1 FORM AND FALSEWORK MATERIALS

- A. Except as otherwise expressly accepted by the DISTRICT, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material.
- B. Materials for concrete forms, formwork and falsework shall conform to the following requirements:
 1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade shown. Metal forms shall be an approved type that will accomplish such results.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces, will not impair subsequent treatments of concrete surfaces, and is free of oils, waxes, and other materials harmful to concrete.

2.2 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form Ties shall be Burke Penta-Tie System, Richmond Snap-Tys, or equal.

2.3 REINFORCEMENT STEEL

- A. General: All reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
 1. Bar reinforcement shall conform to ASTM A 615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise shown.
 2. Welded wire fabric reinforcement shall conform to ASTM A 185 and the details shown.
- B. Accessories:
 1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
 2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

2.4 MATERIALS

- A. Portland cement: ASTM C150-12, Type II/V low alkali, natural color; ACI 301 2.1.
- B. Pozzolans: Coal Fly Ash: ASTM C618; Class C or Class F.
- C. Aggregate:
 1. Provide ASTM C33 normal weight aggregates, size between 3/4" and 1" and with minimum size #4, clean, uncoated crushed stone or gravel coarse aggregate free of materials which cause staining or rust spots; fine aggregate shall be clean natural sand; ACI 301 2.4, of which at least 12% passes a 50-mesh screen.

- 2. Recycled crushed concrete aggregate, ASTM C33 shall be used subject to approval by the Structural Engineer; minimum 25% desired.
- D. Water: Clean, fresh, and potable.
- E. Admixtures:
 - 1. Air-entraining admixture: ASTM C260; ACI 2.2; add as required in ACI 301 3.4.1.
 - 2. Water-reducing admixture: ASTM C494/A; ACI 301 2.2; Euclid, Master Builders Pozzolith, WR Grace or equivalent.
 - 3. Integral concrete colorant: Light-fast, lime proof, finely divided mineral oxide terrazzo matrix coloring. Davis Colors; Solomon Co., L. M. Scofield Company, or equal.
 - 4. The concrete shall not contain calcium chloride or admixtures containing more than 0.05% chloride ions or thiocyanates.
- F. Waterproofing admixture for water feature concrete: XYPEX Admix C-1000/C-2000.

2.5 MIXES

- A. Provide ASTM C94 ready-mixed concrete. Batch mixing at site is not acceptable; ACI 301 3.8.
 - 1. Strength:
 - a. Paving: 2,900 psi minimum at 28 days; ACI 301 3.2, ASTM C31.
 - b. All other concrete 2,500 psi minimum at 28 days; ACI 301.3.2.
 - 2. Slump range: 2" to 4" maximum; ACI 301 3.5. (3" slump for integral color concrete paving)
 - 3. Durability: ACI 301 3.4.
 - 4. Integral concrete colorant: refer to Schedule of Landscape Construction Finishes on the drawings.
 - 5. When using Top-Cast, a 6 sack mix (564 lbs/256 kg cement) should always be used to achieve correct etch.
- B. Maximize cement content of mix:
 - 1. Use 30-35% Fly Ash content of cementitious material.
- C. Provide an approved water-reducing admixture in all concrete. Maximum amount of water shall not exceed 45% by weight of [cement + pozzolans].
- D. Provide an air-entraining admixture in all concrete. Air content 5% to 7%.
- E. Indicate water added to mix at job site on each delivery ticket. Show quantity of water added. Site water tempered mixes exceeding specified slump range will be rejected as not complying with specification requirements.
- F. Mixes for Washed Exposed Aggregate Concrete paving and curbs shall be Gap-Graded to maximize coarse aggregate content to attain a dense, uniform aggregate exposure.
- G. Water feature structure and paving: add waterproofing admixture in accordance with manufacturer's printed instructions for the use intended.

2.6 ACCESSORIES

- A. Aggregate Base Course: Untreated base courses shall be installed under paving where indicated in the Drawings. Material shall be 3/4 inch maximum size broken stone or crushed gravel conforming to the requirements of Class 2 aggregate base of Section 26 of the State Specifications.
- B. Joint Filler: ASTM D1752 Type I, premolded non-extruding neoprene sponge rubber, thickness indicated; with removable polystyrene or PVC strip mechanically attached to the top edge.
- C. Expansion Joint Dowels: No. 4 smooth steel dowels; cover one end with capped cardboard dowel sleeve.

- D. Curing Compound: ASTM C309, Type 1-D, Class A non-yellowing, non-staining liquid membrane-forming type containing a fugitive dye. Chlorinated rubber compounds not acceptable for exterior use.
- E. Joint Sealants: Two-component polysulfide or polyurethane elastomeric type complying with FS TT-S-00227, self-leveling, designed for foot traffic.
- F. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
- G. Cleavage Membrane/Vapor Barrier: 10 mil; black, polyvinyl chloride sheet; fungus resistant.
- H. Step Nosings:
 - 1. Embedded Abrasive Strips: Balco, 800-767-0082, AB-3 Block Strip, color: black, or equal.
- I. Prefabricated Drainage Composite: Three dimensional waffle pattern, high impact polymeric sheet with geotextile backing sheet. Compressive strength 15,000psi; Miradrain 6000 or equal.
- J. Top-Cast surface retarder: www.DaytonSuperior.com

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which the concrete work is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. All foundation bearing surfaces shall be inspected and approved by the Geotechnical Engineer prior to start of formwork.
- C. All formwork and reinforcing shall be reviewed and approved by the Architect prior to placement of concrete.

3.2 LINES AND LEVELS

- A. Finished grades shown on Plans are given in feet and decimals of feet and are to be the top of all graded or paved surfaces. Slope uniformly between given spot elevations unless otherwise indicated.
- B. Surfaces shall be true to within 1/8 inch when tested in any direction with a 10 foot straightedge. There shall be no pools of water standing on the pavement after a rain.
- C. Transition between changes in vertical gradient of walks and paving shall be smooth and gradual with no abrupt or sharp changes.
- D. Horizontal curves and radii shall be laid out tangent to adjacent straight lines or adjacent compound curves. Curves shall be smooth and flowing.
- E. Horizontal layout shall not vary more than 1 inch from dimensions indicated on the Drawings. Make minor field adjustments in the layout as necessary to make radii tangent and curves smooth and flowing as indicated on the Drawings.

3.3 PREPARATION

- A. Preparation of Subgrade: specified in Section 31 2100 - Site Grading.
- B. Aggregate Base
 - 1. Install under paving where indicated on the Drawings.
 - 2. Do not install until subgrade has been approved by the Geotechnical Engineer.
 - 3. Spread the aggregate base on the prepared subgrade to such a depth that when thoroughly compacted it will conform to the grades and dimensions shown on the Drawings. Spread and

compact in accordance with Section 26-1 of the State Specifications. The finished surface shall be smooth, hard, and true to line and grade.

- C. Remove loose material and debris from base surface before placing concrete.

3.4 FORMWORK AND REINFORCING

- A. General: Conform with ACI 301, Chapter 4.
- B. Install, align, and level forms. Stake and brace forms in place. Maintain following grade and alignment tolerances:
 1. Top of form: Maximum 1/8" in 10'-0".
 2. Vertical face: Maximum 1/4" in 10'-0".
- C. Construct formwork carefully so that straight lines are perfectly tangent to radii, curves are smooth and flowing, and transitions between changes in vertical gradient of curbs, walls, walks and paving are smooth and gradual with no abrupt or sharp changes.
- D. Coat form surfaces in contact with concrete with form release agent. Clean forms after each use and coat with form release agent as necessary to assure separation from concrete without damage.
- E. Chamfer Strips: Where chamfered edges are indicated on the drawings, install wood chamfer strips in the forms; tooling of chamfers will not be allowed.
- F. Locate, place, and support reinforcement as indicated on the Drawings.
 1. Paving:
 - a. Provide a single layer of welded wire fabric in all concrete slabs-on-grade, paving and walks unless otherwise indicated.
 - b. Where indicated on the Drawings, provide reinforcing bars in concrete paving.
 2. Provide reinforcing bars in walls, curbs, steps, and other locations indicated, adequately supported and secured to prevent displacement.
- G. Install, set, and build-in work furnished under other specification sections. Provide adequate notification for installation of necessary items.
- H. Install pipe sleeves for irrigation system furnished under Section 32 8400. Stake location of irrigation sleeves.

3.5 INSTALLATION

- A. Concrete Placement: (ACI 301 5.5.3)
 1. Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as specified.
 2. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing. In cold weather comply with ACI 306, "Recommended Practice for Cold Weather Concreting". In hot weather comply with ACI 305, "Recommended Practice for Hot Weather Concreting."
 3. Moisten base to provide a uniform dampened condition at the time concrete is placed. Verify manholes or other structures are at required finish elevation and alignment before placing concrete.
 4. Place and spread concrete to the full depth of the forms. Use only square-end shovels or concrete rakes for hand-spreading and consolidating concrete. Exercise care during spreading and consolidating operations to prevent segregation of aggregate and dislocation of reinforcement.
 5. Free fall shall not exceed eight (8) feet in walls and columns, or five (5) feet in other elements.
 6. Place concrete in a continuous operation between expansion joints. Provide construction joints when sections cannot be placed continuously.
 7. Place concrete in one course, monolithic construction, for the full width and depth of concrete work. Provide minimum 4-inch-thick walks and paving, except as otherwise indicated.

8. Strike-off and bull-float concrete after consolidating. Level ridges and fill voids. Check surface with a 10'-0" straightedge. Fill depressions and refloat repaired areas. Darby the concrete surface to provide a smooth level surface ready for finishing.
9. Do not clean concrete trucks and equipment on site; use a previously designated approved site that meets environmental regulation.

3.6 JOINTS

- A. Construction Joints: locate and install where indicated, or if not indicated, so as to not impair the strength and appearance of the structure.
 1. Provide keyways at least 1-1/2 inch deep in joints in walls and between walls and footings.
 2. Use preformed metal construction joints in paving and slabs.
- B. Control Joints in retaining walls and seat walls: install vertical V-joints formed with 3/4" beveled wood chamfer strips spaced at 10 feet on center minimum, and at changes in direction, or as noted on drawings. Align joints with adjacent paving joints and markings.
- C. Expansion Joints:
 1. Scope: install expansion joints in the following locations, whether shown on the drawings or not:
 - a. Concrete paving: minimum 20' O.C. and at all intersections.
 - b. At vertical surfaces: install joints without dowels at all building walls and other vertical structures.
 2. Hold joint filler straight, true to line and at proper level by stapling to 2X wood form; pour adjacent slabs separately.
 3. Neatly tool edges of joint flush with removable strip.
 4. Carefully remove the removable strip when concrete is sufficiently set.
 5. Avoid sprawling tooled joint edges; any damaged edges shall be repaired to the satisfaction of the Architect.
- D. Score Marks:
 1. Tool or saw-cut score marks as indicated on the drawings.
 2. Tool straight lines with neatly formed radius edges; conform with details shown on the Drawings.
 3. Saw-cut straight lines continuous to vertical surfaces

3.7 FINISHES

- A. Perform concrete finishing using mechanical or hand methods as required. Finishes shall match approved samples.
- B. Integral Color Concrete:
 1. Do not use magnesium floats or tools.
 2. Do not use visquine for curing.
 3. Do not allow excessive surface water.
- C. Upon completion of floating, and after bleed water has disappeared and concrete can sustain foot pressure with nominal indentation, cut concrete away from forms. Work edges with an edging tool. Round edges to 1/4" radius.
- D. Steps: To Receive Broom Finish:
 1. Neatly tool nosings as detailed on the Drawings.
 2. Steel trowel to a smooth, hard finish.
 3. Using a stiff broom, strike clean, crisp broom mark lengthwise along treads and risers.
 4. Finish shall be uniform throughout in color and texture.
 5. Finish of riser faces shall match finish of treads.
- E. Paving to Receive Broom Finish:
 1. Screed and float paving to a smooth, even grade in accordance with the Drawings using overhead screeds where necessary to establish flow lines or grade breaks.

2. Steel trowel to a smooth, hard finish.
3. Using a stiff broom, strike clean, crisp broom marks across paving at right angles to the length of the ramp.
4. Finish shall be uniform throughout in color and texture.

F. Paving to Receive Top-Cast Finish:

1. Screed and float paving to a smooth, even grade in accordance with the Drawings using overhead screeds where necessary to establish flow lines or grade breaks.
2. Bull float a second time.
3. Moisture is needed in the top surface to react with the Top-Cast product. Use the 05 Top Cast product to achieve a sandblast finish. Apply the Top-Cast with a Hudson type sprayer with an adjustable nozzle or a fan type nozzle with a (.3 or .5 GPM). Apply Top-Cast with a sprayer at a rate of approximately 200-300 sf. ft. gal (4.9-7.4 sq. m/L)
4. The Top-Cast will dry on the surface in about 1-2 hours after application depending on ambient temperature and humidity.
5. Generally, wash the slab 12 to 16 hours later, this is totally dependent upon the mix design and ambient temperatures as well as job site conditions and the washing procedure used.
6. Use a power washer with about 1500 PSI and a 25-degree fan nozzle. Wash about 6-10 inches away.
7. Finish shall be uniform throughout in color and texture.

G. Curbing, Headers, Bands and Dividers:

1. Neatly tool edges as detailed on the Drawings.
2. Bring exposed surfaces to a hard, smooth steel trowel finish and then finish with a fine hair broom to produce a uniform crisp, light broom finish parallel to the length of headers and dividers.
3. Finish of curb faces shall match finish of tops.

H. Walls, Seatwalls and Curbwalls:

1. Bring exposed surfaces to a hard, smooth steel trowel finish.
2. Finish shall be uniform in texture and color.

3.8 SEALANTS

- A. Work under this Section includes furnishing and installation of all sealants, backing rods, primers and associated work and materials in expansion joints in concrete work.
- B. Prime joints and install per manufacturers printed instructions.
- C. Hold sealant flush with paving surface.
- D. Sealant shall be smooth with no voids or irregularities.

3.9 ABRASIVE STEP NOSING

- A. Form an appropriately sized channel in the stairs where the abrasive bar system is to be installed.
 1. Size the channel 1/16 inch wider than the abrasive bar on each side.
 2. This can be achieved by casting the channel into poured concrete stairs, or by cutting, grinding or routing the channel into existing concrete.
- B. Install with a nominal 1/16" (2mm) exposed above the stair tread surface.
- C. Ensure that the channel is level, properly configured, and of the correct width and depth for the bar to be installed.
- D. Use compressed air or a brush to remove dust, dirt and debris from the channel prior to installation of the abrasive bars.

3.10 REPAIR OF SURFACE DEFECTS (ACI 301 9.1)

- A. Patching of tie holes is required.

3.11 CURING (ACI 301 12.1)

- A. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.
- B. Apply curing compound in accordance with manufacturer's printed instructions.

3.12 FIELD QUALITY CONTROL (ACI 301, Chapter 16)

- A. Provide field quality control testing and inspection during concrete operations.
- B. Contractor shall provide adequate notice, cooperate with, provide access to the work, obtain samples, and assist test agency and their representatives in execution of their function.
- C. Testing:
 - 1. Provide slump test on first load of concrete delivered each day and whenever requested due to changes in consistency or appearance of concrete.
 - 2. Strength testing:
 - a. Provide 1 set of 3 test specimens for each 50-cu. yd. placed in any one day. Secure samples in accordance with ASTM C172 and mold specimens in accordance with ASTM C31.
 - b. Test 1 specimen at 7 days and 2 specimens at 28 days in accordance with ASTM C39.
 - c. Furnish copies of field records and test reports as follows:
 - 2 copies to Architect
 - 1 copy to Contractor
 - 1 copy to Ready Mix Supplier
 - 3. Record the exact location of the concrete in the work represented by each set of cylinders and show on test reports.
 - 4. Provide an insulated moist box for protection of the test cylinders until shipped to the laboratory.

3.13 MISCELLANEOUS CONCRETE REQUIREMENTS

- A. All other concrete work indicated on the drawings and/or required to complete all the work, shall be provided and installed, even though not specifically mentioned herein.

3.14 PROTECTION

- A. Protect concrete work from damage due to construction and vehicular traffic until final acceptance. Exclude construction and vehicular traffic from concrete pavements for at least 14 days.

3.15 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work.
- B. Remove all bituminous materials, form release agents, curing compounds or other materials employed in the work which would prevent proper application of sealants, liquid water proofing or other specified treatments.
- C. Remove from site all excess materials, debris, and equipment. Repair damage resulting from concrete operations.
- D. Repair any damage done to adjacent work to the satisfaction of the Owner.

END OF SECTION

**SECTION 32 1500
AGGREGATE SURFACING**

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
1. Aggregate Base
 2. Metal Headers
 3. Crushed Aggregate Paving with GraniteCrete admixture surfacing
 4. Unit Paver Banding
 5. Decomposed Granite Mulch

1.02 RELATED WORK

- A. Section 31 2000 – Earth Moving

1.03 REFERENCES AND STANDARDS

- A. Standard Specifications: Where referred to in these Specifications, "State Specifications" shall mean the California CalTrans Specifications, latest edition.
- B. Percent Compaction: As referred to in these Specifications, percent compaction or relative compaction is required in-place dry density of material expressed as a percentage of the maximum dry density of the same material determined in accordance with the ASTM Test Method D-1557-78 (C). Optimum moisture content is the moisture content corresponding to the maximum dry density determined by the ASTM Test Method D-1557-78 (C).
- C. American Society for Testing and Materials, (ASTM).
- D. ASTM C136-Sieve Analysis of Fine and Coarse Aggregates
- E. ASTM D2419- Sand Equivalent Value of Soils and Fine Aggregates

1.04 QUALITY ASSURANCE

- A. Installer qualifications: Installer to provide evidence to indicate successful installations of 25,000 square feet or more, with an additional 6,000 square feet per year in providing decomposed granite surfacing containing GraniteCrete admixture and/or ability to follow installation instructions.
1. Use of GraniteCrete Certified Installers is highly recommended.
 2. Materials shall comply with manufacturer's specifications.
 3. For projects being installed by other than a GraniteCrete Certified Installer, GraniteCrete strongly recommends the use of GraniteCrete personnel onsite to oversee the installation process.
 4. GraniteCrete, Inc. does not offer a warranty on any installation even if completed by a Certified Installer - only on the product, bag-to-bag.
- B. Porous Base Rock Testing:
1. Testing shall occur during installation at weekly increments of shipping for sieve conformance. Results shall be submitted prior to completion of the stone base installation.
 - a. The stone field area shall have a permeable rate no less than 14" per hour. For $\frac{3}{8}$ " minus stone, the permeable rate should be 2.7" per hour. The testing shall be per Din 8035 Part 7, ASTM 2434 (constant head), or ASTM F2898 testing methods.
 - b. In addition to the lab testing, after installation of any aggregate base cross-section, designed to conduct rainfall to the sub-soils and/or under-drain system, the finished aggregate base shall be tested, in situ for infiltration rate, using method ASTM F2898.

The test shall be performed by a registered Geotechnical Engineer or certified agronomist.

2. The Contractor is responsible to meet this performance specification, before proceeding with installation, and shall bear the cost of the on-site.
 3. testing and the cost of any additional work necessary to achieve compliance with the specification.
 4. All test results shall be logged and documented by the Owner's Technical Representative or Geotechnical Engineer. If at any time the processed stone base does not meet specifications, it shall be the Contractor's responsibility to restore, at his expense, the processed stone base to the required grade, cross-section and density.
 5. After the contractor has independently confirmed compliance with all the above tolerances, he shall notify the appropriate party and schedule a final inspection for approval. The contractor shall make available an orbital laser system to the Inspection Team for the inspection process.
 6. The compaction rate for porous base rock should be 88%.
- C. Decomposed Granite paving shall comply with these specifications and all applicable sections of the above-named references and standards.
- D. Sample Panel: Before starting several gravel paving areas, provide a sample panel including metal headers. Build panel at the site of full thickness and approximately 4 feet x 4 feet. Correct and rebuild sample panel until Architect's acceptance of the work. Retain panel during construction as a standard for completed paving work.
- E. Do not change source of material during the course of the work.

1.05 SUBMITTALS

- A. Submit manufacturer's product data, specifications and samples of each gravel.
- B. Submit the following material samples for the Resident Engineer's written approval prior to delivery of materials to site, or preparation of sample panel. Provide suppliers sieve analysis with each sample.
 1. Base Course: one-half cubic foot.
 2. Surface Course: one-half cubic foot.
- C. Submit material certificates for base materials.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store loose granular materials in a well-drained area on a solid surface to prevent mixing with foreign materials.
- B. Deliver all GraniteCrete Admixture materials in original, unopened packaging. Protect from contamination with foreign matter. Store under waterproof cover and protect from dampness.

1.07 PROJECT CONDITIONS

- A. Review installation procedures and coordinate paving work with other work affected by crushed gravel paving work.
- B. Do not install crushed aggregate blended with GraniteCrete admixture surfacing when sub-base is wet at saturated capacity.
- C. Do not install GraniteCrete materials during rainy conditions or below 40 degrees Fahrenheit.
- D. Protect partially completed paving against weather damage when work is not in progress.
- E. Provide temporary barricades and warning lights as required for protection of project work and public safety.
- F. Protect adjacent work from damage, soiling, or staining during paving operations.

1.08 LAYOUT OF THE WORK

- A. A licensed surveyor or registered civil engineer shall lay out and establish all lines, levels, grades, and positions of all parts of the work.

PART 2 PRODUCTS

2.01 CRUSHED AGGREGATE BLENDED WITH GRANITECRETE ADMIXTURE SURFACING

- A. Acceptance Manufacturer: GraniteCrete, Inc., 800-670-0849, www.granitecrete.com.
- B. Color: as shown on drawings.
- C. Decomposed granite: color: Gold/tan. Maximum dry density: 130 pcf, optimum moisture: 8.8%. DG shall have a 3/8" maximum gradation, produced from naturally friable rock/granite with enough fines to produce a smooth walking surface. Materials should be free from clay lumps, organic matter, and deleterious material. Blends of coarse sand and rock dust are not acceptable.

Sieve Size	Percent Passing
1/2"	100
3/8"	95-98
#4	85-90
#8	75-85
#16	55-70
#30	38-57
#50	24-33
#100	15-24
#200	9-18
#400	0-9

2.02 DECOMPOSED GRANITE MULCH

- A. Decomposed granite: color: Gold/tan. Maximum dry density: 130 pcf, optimum moisture: 8.8%. DG shall have a 3/8" maximum gradation, produced from naturally friable rock/granite with enough fines to produce a smooth walking surface. Materials should be free from clay lumps, organic matter, and deleterious material. Blends of coarse sand and rock dust are not acceptable.

Sieve Size	Percent Passing
#4	85-100
#8	55-80
#30	30-45
#200	10-20

2.03 BASE COURSE

- A. 3/4" Class II permeable aggregate base material per State Specifications.

Sieve Size	Percent Passing*	
	Intended Result	Range
1"	100	100
3/4"	100	90-100
3/8"	78	40-100
#4	36	25-40
#8	26	18-33
#30	11	5-15
#50	6	2-10
#200	2	0-5

* AASHTO Test Method T-27

- 1. Durability Index (CTM# 229) 40 min
- 2. Sand Equivalent (CTM# 217) 70
- 3. LA Rattler (CTM# 211) 500 Revs, less than or = 40%

2.04 ACCESSORIES

- A. Metal header: Aluminum edging, Cleanline, 3/16"x 4" as manufactured by Permaloc Corp. (800) 356-9660 or equal. Color to be black.
- B. Unit Pavers: Manufacturer: Pacific Interlock Pavingstone, 831-578-4978
 - 1. Paver Type: Hydro-Flo Plaza Paver.
 - a. Material Standard: Comply with ASTM C 936.
 - b. Color Pigment Material Standard: Comply with ASTM C 979, see drawings for specific color.
 - c. Sizes: 6 inches x 9 inches x 2.4 inches thick

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate under which paving is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 LINES AND LEVELS

- A. Finished grades shown on Plans are given in feet and decimals of feet and are to be the top of all graded or paved surfaces. Slope uniformly between given spot elevations unless otherwise indicated.
- B. Surfaces shall be true to within 1/8 inch when tested in any direction with a 10-foot straightedge. There shall be no pools of water standing on the pavement after a rain.
- C. Transition between changes in vertical gradient of walks and paving shall be smooth and gradual with no abrupt or sharp changes.
- D. Horizontal curves and radii shall be laid out tangent to adjacent straight lines or adjacent compound curves. Curves shall be smooth and flowing.
- E. Horizontal layout shall not vary more than 1 inch from dimensions indicated on the Drawings. Make minor field adjustments in the layout as necessary to make radii tangent and curves smooth and flowing as indicated on the Drawings.

3.03 PREPARATION OF SUBGRADE

- A. Preparation of subgrade: specified in Section 31 2000 – Earth Moving.
- B. Install class II permeable base rock at 88% compaction.

3.04 WEED CONTROL

- A. Apply soil sterilizer over subgrade prior to installing paving in accordance with the manufacturer's printed instructions.

3.05 INSTALLATION

- A. Metal Headers
 - 1. Preparation: Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work. Locate border line of edging with string or other means to assure border straightness and curves as designed. Dig trench 1 inch deeper than set of edging bottom.
 - 2. Set edging into trench with top at 1/2 inch above compacted finish grade on turf side with side having loops for stakes placed on opposite side of turf. Drive stakes through edging loops until locked in place. Requires 5 stakes evenly spaced for each 16 feet section, or 3 stakes evenly spaced for each 8 feet section for a total of 8 stake loops available in each 16 feet section if necessary. Provide additional stakes at approximately 24 inches apart, longer

- stakes, heavier gauge stakes, or any combination of previously mentioned as necessary to firmly secure edging for permanent intended use.
3. Where edging sections turn at corners and at angled runs, cut edging partially up through its height from bottom and turn back to desired angle to form rounded exposed radius.
- B. Crushed Aggregate Paving with GraniteCrete admixture surfacing
1. Place the unit paver banding in place prior to installing GraniteCrete paving.
 2. GraniteCrete mix ratio:
 - a. Eleven (11) units of decomposed granite to one-and-one-half (1.5) units of GraniteCrete admixture.
 3. Class II Permeable Base Rock: Moisten and compact base rock on entire installation area to an even depth of 6-inches. A vibratory plate can be used to compact the base rock to 88%.
 4. Install GraniteCrete as a 4-inch thick layer (lift) over a 6-inch subgrade of compacted Class II base rock. Compaction rates for all applications are 88%–92%.
 5. After DG and GraniteCrete have been mixed but BEFORE installation has begun: Mix thoroughly and moisten with water until the GraniteCrete mixture begins to marble or clump together. Squeeze the mixture in your fist and open your hand. When the color has just started to transfer onto your hand and the mixture just begins to stay together in a clump, it is ready for installation.
 6. GraniteCrete: Wheelbarrow the prepared GraniteCrete to the installation site and spread the mixture over the compacted base rock.
 7. Initial Compaction: Walking on the area is acceptable; initial compaction can be performed by walking on the edges and corners. Rake or grade area with the flat side of a landscape or asphalt rake (Do not use tang side), until the GraniteCrete is one inch above finish grade.
 - a. Hand tamp (with a 10" hand tamp) around benches, signposts, corners, boulders, etcetera. Pay particular attention to corners and edges to ensure tight compaction.
 8. Final Compaction: Make several passes with a 36" lawn roller (filled with water) or a 36" walk-behind or riding-roller in static position. Hand tamp out any imperfections with a 6" wooden masonry float.
 9. Make sure to keep your 10" hand tamp, lawn roller, and wooden floats clean at all times. Fill in any divots with fresh, loose material (removing any larger stones) and hand tamp with the wooden floats to match finish.
 10. When laying GraniteCrete in batches, be sure to use the cold joints to ensure a blemish-free installation.
 11. Finishing: Remove spoils off the surface.
 12. DO NOT ALLOW GRANITECRETE TO DRY. MIST LIGHTLY WITH A HOSE END SPRAY HEAD AS NECESSARY OR COVER WITH A PLASTIC TARP.
 13. At completion of installation: Dampen with water of all newly installed and compacted GraniteCrete materials.
 - a. Using a shower head/spray hose attachment, moisten the entire newly installed GraniteCrete area; avoid puddling.
 - b. Moisten a second time the following 1 to 5 days, as practical. Slow curing of GraniteCrete is important to avoid cracking.
 14. Cold Joints: temporary cold joints can be used at the end of the work day.
 - a. Method One:
 - 1) "Between pours," stop at an area that makes the joint location look intentional. Take a chalk snap line just back from loose GraniteCrete into the compacted area and create a chalk line. Use either a masonry blade or a square-nose shovel and cut a straight line across the installation.
 - 2) Continue with installation. Place newly mixed GraniteCrete into area, being careful not to overlap existing compacted material. With a concrete trowel or similar tool, tamp the new material at a tapered, 45 degree angle 1" above the finished grade and compact. If necessary, "feather" in with a medium-bristled broom.
 - b. Method Two:
 - 1) Place a 2x4 or 2x6 piece of wood across the installation, stake it, and finish compacting the material. Leave the board in place overnight.

- 2) The next day, carefully lift the wood up and away from the installed GraniteCrete. Place newly mixed GraniteCrete into area, being careful not to overlap existing compacted material. With a concrete trowel or similar tool, tamp the new material at a tapered, 45 degree angle 1" above the finished grade and compact. If necessary, "feather" in with a medium-bristled broom.
 15. Trowel control joints every +/-5 feet in narrower paths, every +/-12 feet in wider paths, and at every engineered stress areas. Refer to drawings for locations.
 16. Completed, finished surface shall be of consistent quality and free of deleterious materials such as organic materials, nails, stones, and loose material. Surface shall not have depressions or humps greater than 1/4 inch in ten feet. Cold joints, if any, should be inconspicuous.
- C. Decomposed Granite Mulch
1. General: Uniformly spread approved material and compact to grades and lines shown. Compaction shall be made by using a lawn roller filled with water to 88%.
 2. Finish surface of tree wells shall be uniform in appearance as to texture and color, shall have a firm stable consistency, and shall be flush with adjacent paving.

3.06 PROTECTION

- A. Restrict traffic from paving surfaces during and until completion of installation.
- B. Do not allow traffic on GraniteCrete admixture surfacing until compacted crushed aggregate blended with GraniteCrete admixture surfacing has fully cured. Cover for extended curing period.
 1. Newly installed GraniteCrete paving surfaces are fully cured in 28 days. At that time, the entire surface should be blown or swept off to eliminate loose surface materials.
- C. Protect paving surfaces from damage until project completion. Repair damaged areas to match specified requirements.

3.07 MAINTENANCE & REPAIRS

- A. Follow manufacturer's recommendations.
- B. Maintenance: Maintenance may require occasional blowing off or brooming of paved surface. Depending on quality of compaction at time of installation, a thin veneer of loose aggregate material is typical after the full 28 days cure period. If cracking appears in a GraniteCrete surface, broom loose aggregate "fines" into cracks and compact with a rubber mallet.
- C. Repair: When repairing GraniteCrete, use the original aggregate and the original GraniteCrete Admixture color to match previously installed materials. If the paved surface has large areas of raveled material (loose aggregate) the initial installation may not have been properly compacted, or blended materials did not have optimum moisture content during installation:
 1. For the large loose areas, a minimum of a 3-inch of GraniteCrete can be installed. The repair areas need to be saw-cut at agreed length, removed, and re-installed. A portable concrete mixer or wheelbarrow can be used. Batch proportions are 33 shovelfuls of aggregate/decomposed granite to 3 shovelfuls of GraniteCrete Admixture (11:1 ratio). (A "shovelful" is equivalent to 10 pounds.) The mixture must be thoroughly dry mixed and moistened to specifications.
 2. In areas that collapse/fail due to equipment weight, re-form and re-install with original materials as per specifications.
 3. Cracks: Repair by brooming existing surface fines into the cracks of filling with dry, pre-mixed materials, or both. The onsite aggregate should be sieved to 1/8" minus material for better application and in-fill of cracks. Materials should be mixed as per ratio described above. Broom or fill the crack, moisten, compact (with rubber mallet or hand compaction plate) and "feather" material into the final finish.

3.08 CLEANING

- A. Perform cleaning during installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from crushed stone paving operations.

END OF SECTION

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**SECTION 32 1713
PARKING BUMPERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete parking bumpers and anchorage.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Provide unit configuration, dimensions.

1.03 SUSTAINABILITY

- A. CAL-Green documentation and verification data as specified in Section 01 8114 Sustainable Design Requirements - CAL-Green, for the following measures:
 1. 4.504.2.1 and 5.504.4.1 Adhesives and sealants.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 3 years experience in production of parking bumpers specified.
- B. Certifications: Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Parking Bumpers: Precast concrete, complying with the following:
 1. Nominal Size: 4-1/2 inches (114.3 mm) high, 9 inches (228.6 mm) wide, 6 feet (2m m) long.
 2. Profile: Manufacturer's standard.
 3. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 4. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 5. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 6. Air Entrainment Admixture: ASTM C260/C260M.
 7. Concrete Mix: Minimum 5,000 psi (34 MPa) compressive strength after 28 days, air entrained to 5 to 7 percent.
 8. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 9. Embed reinforcing steel, and drill or sleeve for two dowels.
 10. Provide chamfered corners, transverse drainage slots on underside.
 11. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 12. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- B. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch (13-mm) diameter, 10-inch (254-mm) minimum length.
 1. Location: Exterior asphalt parking surfaces.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.

- B. Install units in alignment with adjacent work.
- C. Site Installation: Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION

**SECTION 32 1723.13
PAINTED PAVEMENT MARKINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Parking lot markings, including crosswalks, arrows, and curb markings.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to marking pavement including, but not limited to, the following:
 - a. Pavement aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
- B. Informational Submittals:
 - 1. Certificates: Submit for each batch of paint and glass beads stating compliance with specified requirements.
- C. Closeout Submittals:
 - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. Refer to Section 01 6000 - Product Requirements, for additional provisions.
 - b. Extra Paint: 2 containers, 1 gallon (4 liter) size, of each type and color.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 018114 - Sustainable Design Requirements – CAL-Green, for the following measures:
 - 1. 4.504.2.2 and 5.504.4.3 Paints and coatings.
 - 2. 4.504.2.3 and 5.504.4.3.1 Aerosol paints and coatings.
 - 3. A5.405.1: Regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing quality paint products with 3 years minimum experience.
- B. Applicator Qualifications: Company specializing in commercial parking lot painting with 3 years minimum documented experience.
- C. Regulatory Requirements: Comply with ADA, local, state laws and ordinances for barrier free accessibility.
- D. Certifications:
 - 1. Submit certified test reports of proposed materials for review before placing order for Project.
 - 2. Certify proposed material meets Specification requirements and reference standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons (18 L) accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.

1.07 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 GENERAL

- A. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible route to an entrance or to multiple accessible entrances. CBC Sections 11B-208.3.1
- B. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. CBC Sections 11B-208.3.1
- C. Minimum number of required accessible parking spaces shall be provided in accordance with CBC Table 11B-208.2 for each parking facility provided.
- D. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. CBC Section 11B-208.2.4
- E. Accessible parking spaces and access aisles shall comply with CBC Section 11B-502 and shall be dimensioned to the centerline of the marked lines as follows:
 - 1. Parking spaces and access aisles shall be marked according to CBC Figures 11B- 502.2, 11B-502.3, and 11B-502.3.3. Their surfaces shall comply with CBC
 - 2. Section 11B-302 and shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-502.4
 - 3. Parking spaces shall be 9 by 18 foot minimum and van parking spaces shall be 12 by 18 foot minimum with an adjacent access aisle of 5 by 18 foot minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9 by 18 foot minimum where the access aisle is 8 by 18 foot minimum.
 - 4. Access aisles shall be marked by a blue painted borderline around their perimeter.
 - 5. The area within the blue borderlines shall be marked with hatched lines a maximum of 36 inches on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3
 - 6. Access aisles (parking spaces as well - similar application) shall not overlap the vehicular way. CBC Section 11B-502.3.4
 - 7. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. CBC Section 11B-502.5
- F. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with CBC Sections
 - 1. 11B-209 and 11B-503 as follows:
 - a. Vehicle pull-up spaces shall be 8 by 20 foot minimum. Access aisles shall be by 20 foot minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-503.4
 - b. Access aisles for passenger drop-off and loading zone shall be marked with a painted borderline around their perimeter. The area within the borderlines shall be marked with

hatched lines a maximum of 36 inches on center in a color contrasting with that of the aisle surface. CBC Section 11B-503.3

- c. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. CBC Section 11B-503.5
- G. Bus loading zones and bus stops shall comply with CBC Sections 11B-209 and 11B-
- 1. as follows:
 - a. Boarding and alighting areas shall be of 8 by 5 foot minimum, with 8 feet measured perpendicular to the curb or vehicle roadway edge, and with 5 feet measured parallel to the vehicle roadway. Slopes in 8 feet direction shall be 1:48 maximum. Slopes in 5 feet direction shall be the same as that of the roadway, to the maximum extent practicable. CBC Figure 11B-810.2.2
 - b. Bus shelters shall provide a minimum 30 by 48 inches clear floor or ground space (36 by 48 inches or 36 by 60 inches as applicable in an alcove), with slopes not steeper than 1:48 in any direction, entirely within the shelter complying with CBC Section 11B-305.
 - c. Bus shelters shall be connected by an accessible route complying with CBC Section 11B-402 to a boarding and alighting area complying with CBC Section 11B-810.2. CBC Figure 11B-810.3

2.02 MATERIALS

- A. CAL-Green Requirements for typical paint coatings:
 - 1. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water
 - 2. Flats: 50 grams per liter of product minus water
 - 3. Non-flats: 100 grams per liter of product minus water
 - 4. Non-flat High Gloss: 150 grams per liter of product minus water
- B. Pavement-Marking Paint: Latex traffic-marking paint.
 - 1. Color: As indicated. Comply with requirements of local authorities having jurisdiction.
 - 2. Traffic Markings: Yellow.
 - 3. Fire Lanes: Red.
 - a. "FIRE LANE – NO PARKING" shall be painted on the top of curb in 3 inches (76.20 mm) white lettering at a spacing of 30 feet (10 m) on center or portion thereof.
 - 4. "NO PARKING" Curbs: Red.
 - 5. "LOADING ZONE" Curbs: Yellow.
 - 6. Accessibility (ISA) Symbol 2 inches (50.8 mm) White on blue background.
 - 7. Traffic paint to include evenly dispersed, fine-aggregate additive. Striping and pavement marking to be textured, slip-resistant coating, complying with 11B-302.1.
 - 8. Acceptable Products:
 - a. Benjamin Moore & Co.; P58/KP58 Safety & Zone Marking Latex.
 - b. Dunn-Edwards Corporation; W801 Vin-L-Stripe.
 - c. Pervo Paint Company; Acrylic Traffic Paint.
 - d. Sherwin-Williams Company (The); TM227/TM226 Setfast Acrylic Waterborne Traffic Paint.
 - e. Prior approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F (10 degrees C) or more than 95 degrees F (35 degrees C).
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
 - 1. Apply paint in one coat only.
 - 2. Wet Film Thickness: 0.015 inch (0.4 mm), minimum.
 - 3. Length Tolerance: Plus or minus 3 inches (75 mm).
 - 4. Width Tolerance: Plus or minus 1/8 inch (3 mm).
- G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
 - 1. Conduct operations in such a manner that necessary traffic can move without hindrance.
 - 2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
 - 3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
 - 4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
 - 5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
- H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
 - 1. Mark the International Handicapped Symbol at indicated parking spaces.
 - 2. Hand application by pneumatic spray is acceptable.

- I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

END OF SECTION

**SECTION 32 1726
TACTILE WARNING SURFACING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

1.02 SUBMITTALS

- A. Action Submittals:
 1. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
 2. Samples: For each product specified provide two samples, 8 inches (203 mm) square, minimum; show actual product, color, and patterns.
 3. Shop Drawings: Submit plan and detail drawings. Indicate:
 - a. Locations on project site. Demonstrate compliance with referenced accessibility standards.
 - b. Sizes and layout.
 - c. Pattern spacing and orientation.
 - d. Attachment and fastener details, if applicable
- B. Informational Submittals:
 1. Warranty: Submit manufacturer warranty; complete forms in Owner's name and register with manufacturer.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F (4 and 32 degrees C).

1.05 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Adhesive Application:
 1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

1.06 WARRANTY

- A. Refer to Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS

2.01 TACTILE AND DETECTABLE WARNING DEVICES

- A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles[with replaceable surface] configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
 - 1. Basis of Design Product:
 - a. ARMOR-TILE; Armor-Tile Cast in Place: www.armor-tile.com
 - b. Other Acceptable Manufacturers:
 - 1) Advanced Surface Systems, LLC.
 - 2) AlertTile; a division of Cape Fear Systems, II, LLC.
 - 3) Detectable Warning Systems, Inc.
 - 4) Detectile Corp.
 - 5) StrongGo Industries, LLC.
 - 6) Transpo Industries, Inc.
 - 7) Prior approved equal.
 - 2. Material: Cast-fiber-reinforced polymer concrete tile.
 - 3. Color: Safety yellow.
 - 4. Installation Method: Cast in place replaceable.
 - a. Shape: Rectangular.
 - b. Width: 36 inches (914 mm)
 - c. Edge: Square.
 - d. Joint: Butt.
 - 5. Dome Spacing and Configuration: Manufacturer's standard compliant spacing, in manufacturer's standard pattern.
 - 6. Surfaces with truncated domes shall comply with 11B-705. Sound-on-cane contact shall differ from surrounding surfaces.
 - 7. Mounting:
 - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

PART 3 EXECUTION

3.01 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
 - 1. Examine work area with installer present.
 - 2. If existing conditions are not as required to properly complete the work of this section, notify Architect.
 - 3. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
 - 1. Do not install when ambient or substrate temperature has been below 40 degrees F (4 degrees C) during the preceding 8 daylight hours.
- B. Cast-in-Place Detectable Warning Tiles:
 - 1. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

2. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch (3 mm) from flush.
3. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
4. Clean tiles using methods recommended in writing by manufacturer.

C. Install units fully seated to substrate, square to straight edges and flat to required slope.

3.03 CLEANING

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

3.04 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

**SECTION 32 1816
SYNTHETIC RESILIENT PAVING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Poured-in-place synthetic resilient paving placed on concrete subslab.

1.02 RELATED WORK

- A. Section 32 1313 – Site Concrete
- B. Section 11 6813 – Playground Equipment

1.03 REFERENCES AND STANDARDS

- A. Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, American Society for Testing and Materials, ASTM F 1487.
- B. Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension, ASTM D412.
- C. Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers, ASTM D624.
- D. Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor surfaces as Measured by the James Machine, ASTM D2047.
- E. Standard Test Method for Flammability of Finished Textile Floor Covering Materials, ASTM D2859.
- F. Standard Test Method for Measuring Surface Frictional Properties using the British Pendulum Tester, ASTM E303.
- G. Standard Specifications for Impact Attenuation of Surface Systems under and Around Playground Equipment, ASTM F1292.
- H. Standard Specification for Determination of Accessibility of Surface Systems under and Around Playground Equipment, ASTM F1951.
- I. Handbook for Public Playground Safety, Consumer Product Safety Commission Guidelines, (USCPSC).
- J. Standard Specifications: where referred to in these Specifications, "State Specifications" shall mean the California CalTrans Specifications, latest edition.

1.04 QUALITY ASSURANCE

- A. Resilient Paving work shall comply with these specifications and all applicable sections of the above-named References and Standards.
- B. Installation: Performed only by skilled workmen with satisfactory record of performance on completed projects of comparable size and quality.
- C. Sample Panel: Before starting resilient paving, provide a sample panel using materials, patterns, and joints indicated for project work. Build panel at the site of full thickness and approximately 3 feet x 3 feet. Correct and rebuild sample panel until Architect's acceptance of the work. Retain panel during construction as a standard for completed paving work.
- D. Test Results: Impact attenuation test results shall be provided to the Owner or Owner's representative. These test results shall be certified by and submitted on independent testing

laboratory letterhead. Test results shall meet or exceed USCPSC guidelines for impact attenuation.

- E. Flammability: Resilient paving shall comply with surface flammability requirements of HUD/FHA DM-73 as tested under ASTM E-84 Flame Spread Tests.

1.05 SUBMITTALS

- A. Submit manufacturer's product data and installation instructions for Resilient Paving.
- B. Submit 2 - 6"x 6" samples of each color of the material required.
- C. Submit manufacturer's certification that resilient paving complies with specified material and physical requirements.

1.06 WARRANTY

- A. Paving shall be warranted for labor and materials for a period of not less than two (2) years.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect resilient paving materials from damage during delivery and storage.
- B. All component parts shall be pre-measured and sealed in individual containers.

1.08 PROJECT CONDITIONS

- A. Review installation procedures and coordinate paving work with other work affected.
- B. Protect partially completed paving against weather damage when work is not in progress.
- C. Provide temporary barricades and warning lights as required for protection of project work and public safety.
- D. Protect adjacent work from damage, soiling, or staining during paving operations.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Surface America; Ross Recreation, 707-526-4800.
- B. FibarPIP; Fibar Playground Surfaces, 800-342-2721.

2.02 MATERIALS

- A. General: Poured-in-place, seamless, resilient safety surface conforming with ASTM F-1292/91 Headform drop test and CPSC NBSIR-79-1707.
- B. Resiliency:
 - 1. 100% Memory.
 - 2. Breaking elongation: 130% at 72 degree (F).
- C. Cushion Layer: two types of shredded SBR rubber particles held in place by polyurethane binder applied to 100% of the particles.
 - 1. Type 1: 1 mm - 2mm cubical.
 - 2. Type 2: 0.5mm - 2mm thick x 0.25cm - 2cm in length strand.
- D. Wearing Layer: EPDM Rubber granules, 1mm - 4mm chipped, held in place by polyurethane binder applied to 100% of the granules. Colors as indicated on the drawings.
- E. Durability: Since the material is designed to readily percolate water, it shall have the ability to withstand rainfall and general water intrusion without degradation.

- F. Concrete base: in accordance with Section 32 1313, Site Concrete.
- G. Aggregate Base: Class 2 Base Material in accordance with Section 68 of the State Specifications.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate under which resilient paving is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean the subslab in accordance with the paving manufacturer's printed instruction

3.03 LINES AND LEVELS

- A. Finished grades shown on Plans are given in feet and decimals of feet and are to be the top of all graded or paved surfaces. Slope uniformly between given spot elevations unless otherwise indicated.
- B. Surfaces shall be true to within 1/8 inch when tested in any direction with a 10 foot straightedge. There shall be no pools of water standing on the pavement after a rain.
- C. Transition between changes in vertical gradient of walks and paving shall be smooth and gradual with no abrupt or sharp changes.
- D. Horizontal curves and radii shall be laid out tangent to adjacent straight lines or adjacent compound curves. Curves shall be smooth and flowing.
- E. Horizontal layout shall not vary more than 1 inch from dimensions indicated on the Drawings. Make minor field adjustments in the layout as necessary to make radii tangent and curves smooth and flowing as indicated on the Drawings.

3.04 INSTALLATION

- A. Install resilient paving in accordance with the paving manufacturer's printed instructions.
- B. Trowel to a smooth, even, uniform surface. Slope to drain as indicated on the plans. Grading tolerances shall be as specified for concrete paving in Section 32 1313.
- C. Color and texture shall be uniform throughout.
- D. Neatly finish play edges; provide continuous key slot.
- E. Coordinate with location and attachment of play equipment to produce a safe neat appearance.

3.05 PROTECTION

- A. Restrict traffic and protect resilient paving surfaces at all times until final acceptance of the work by the Owner.

3.06 CLEANING

- A. Perform cleaning during installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage and/or staining resulting from paving operations.

END OF SECTION

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**SECTION 32 1817
FIBROUS RESILIENT PAVING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work included: fibrous materials, sub drainage and drainage collector system.
- B. Submittals.
- C. Quality assurance.
- D. Product delivery and storage.

1.2 REFERENCES AND STANDARDS

- E. Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, American Society for Testing and Materials, ASTM F 1487.
- F. Handbook For Public Playground Safety, Consumer Product Safety Commission Guidelines, (USCPSC).
- G. Standard Specifications: where referred to in these Specifications, "State Specifications" shall mean the California CalTrans Specifications, latest edition.
- H. Fibar System 300 Specifications.

1.3 QUALITY ASSURANCE

- I. Fibrous resilient paving work shall comply with these specifications and all applicable sections of the above-named References and Standards.
- J. Installation: Performed only by skilled workmen with satisfactory record of performance on completed projects of comparable size and quality.
- K. Test Results: Impact attenuation test results shall be provided to the Owner or Owner's representative. These test results shall be certified by and submitted on independent testing laboratory letterhead. Test results shall meet or exceed USCPSC guidelines for impact attenuation.
- L. Flammability: fibrous resilient paving shall comply with surface flammability requirements of HUD/FHA DM-73 as tested under ASTM E-84 Flame Spread Tests

1.4 SUBMITTALS

- M. Submit manufacturer's product data and installation instructions for fibrous resilient paving.
- N. Submit samples of the materials.
- O. Submit manufacturer's certification that fibrous resilient paving complies with specified material and physical requirements.
- P. ASTM F 1292 Standard Specification for Impact Attenuation for Surface Systems Under and Around Playground Equipment:
 - 1. Submit test results for Engineered Wood Fiber and FibarMats for impact attenuation in accordance with. Results must be provided for new material and for 12-year old Engineered Wood Fiber material.
 - 2. Submit test results of Engineered Wood Fiber must showing G-max values of less than 155G for the 8" thick system, or 120G for the 12" system at 12' drop heights, and HIC values of less than 1,000 for both new and 12-year-old material.

3. Submit test results of FibarMats showing G-max values of less than 200G, and HIC values of less than 1,000 for a 3' drop height.
- Q. ASTM F 2075 Specification for Engineered Wood Fiber for Use as Playground Safety Surface Under and Around Playground Equipment:
 1. Submit test results for the Engineered Wood Fiber.
 2. Test results must show the results to determine the presence of tramp metal particles. Metal particles embedded or mixed in Engineered Wood Fiber may cause injury if a child were to fall on/or come in contact with them. The limit for tramp metal was set to reduce the potential of injury.
- R. ASTM F 1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment:
 1. Submit test results to show compliance.
 2. Supplier must certify that the surface meets the intent of the Americans with Disabilities Act (ADA).
- S. Submit written manufacturer's 15-year warranty against loss of resiliency, lifetime warranty on FibarFelt fabric material.
- T. Submit product liability insurance certificate with project owner named as certificate holder, prior to delivery.

1.5 WARRANTY

- U. Fibrous resilient paving is be warranted for labor and materials for a period of 25 years in accordance with the manufacturer's specifications.
- V. To preserve warranty, FibarMat wear mats must be installed under all swings, tire swings, and slide exits. They should also be installed at other excessive wear areas, including sliding poles.

1.6 DELIVERY, STORAGE, AND HANDLING

- W. Protect fibrous resilient paving materials from damage and contamination during delivery and storage.

1.7 PROJECT CONDITIONS

- X. Review installation procedures and coordinate paving work with play equipment installation subdrainage work and other work affected.
 1. Provide temporary barricades and warning lights as required for protection of project work and public safety.
 2. Protect adjacent work from damage, soiling, or staining during paving operations.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Fibar Playground Surfaces: 800.342.272

2.2 ACCEPTABLE MATERIALS

- B. FibarSystem 300.

2.3 ENGINEERED WOOD FIBER

- C. Surfacing shall be IPEMA-certified Engineered Wood Fiber. Standard wood chips, bark mulch, or material manufactured from recycled pallets will not be acceptable.
- D. Shredded wood fiber consisting of randomly sized pieces.

1. North American hardwoods such as Oak, Maple, Ash, Poplar, Hickory, Beech, Birch, And Locust.
 2. All wood debarked, free of soil, leaves, twigs and other contaminates.
 3. No chemical treatment or additives will be allowed.
 4. Standard wood chips, bark mulch or materials from recycled pallets are NOT acceptable.
- E. The amount of Fibar Engineered Wood Fiber necessary to provide the approximate depth after compaction.
- | Depth | Quantity |
|-------|---|
| 8" | 38 cubic yards per 1,000 sq. ft. of playground area |
| 9" | 42 cubic yards per 1,000 sq. ft. of playground area |
| 10" | 46 cubic yards per 1,000 sq. ft. of playground area |
| 11" | 48 cubic yards per 1,000 sq. ft. of playground area |
| 12" | 50 cubic yards per 1,000 sq. ft. of playground area |

2.4 DRAINAGE SYSTEM

- F. Patented under U.S. Patent numbers 4,679,963; 5,026,207 and 5,076,726 and other patents pending.
- G. Fibar Drain
1. Drainage matrix that channels water away from playground.
 2. Minimum flow rate of 10 gpm/ft.
 3. Needle-punched 100% non-woven geotextile sleeve encasing a monofilament nylon mesh.
 4. Laid out on 6'-0" centers in the direction of the grade.
 5. Prevents deterioration of Fibar Engineered Wood Fiber.
- H. Fibar Felt
1. Needle-punched 100% non-woven geotextile fabric that separates the Engineered Wood Fiber from soil below.
 2. Material allows water to flow through, and prevents rocks and soil contamination of the Engineered Wood Fiber.
 3. Designed to cover the sub-grade and drainage matrix to ensure proper drainage.
 4. Seams should be overlapped 3".

2.5 ACCESSORY ITEMS

- I. Fibar Mat
1. 3' x 3' 1.5" with beveled edges (ADA compliant) on all sides.
 2. Placed under each swing seat, tire swings, slide exit, and sliding poles.
 3. Prevents excessive wear under swings and slides.
 4. Mat to be placed on top of the Engineered Wood Fiber.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which resilient paving is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- B. Install fibrous resilient paving in accordance with the manufacturer's printed instructions.
- C. Install quantity of material necessary to achieve the compacted thickness indicated on the drawings, and meeting ASTM and USCPSC headfall requirements.
- D. Avoid contamination of the Fibar Engineered Wood Fiber with sand, gravel, mud, or native soil.

- E. Finished grade and compaction shall be uniform throughout.
- F. Coordinate with location and attachment of play equipment to produce a safe neat appearance.

3.3 **PROTECTION**

- G. Restrict traffic and protect fibrous resilient paving surfaces at all times until final acceptance of the work by the Owner.

3.4 **CLEANING**

- H. Perform cleaning during installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage and/or staining resulting from paving operations.

END OF SECTION

**SECTION 32 3118
METAL FENCES AND GATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnish and install pedestrian fencing and gates as shown on the landscape drawings.
- B. Furnish and install pedestrian guardrail as shown on the landscape drawings.

1.02 RELATED SECTIONS

- A. Section 32 1313 – Site Concrete

1.03 SYSTEM DESCRIPTION

- A. The manufacturer shall supply a total fence and gate system of Montage II Welded and Rackable, Ornamental Steel including all components (i.e., panels, posts, gates, wheels and hardware) required.
 - 1. Fencing and gates design shall be 3-rail Majestic as shown on the landscape drawings.

1.04 QUALITY ASSURANCE

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.06 SUBMITTAL

- A. The manufacturer's literature shall be submitted prior to installation.

1.07 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 PRODUCT WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. The fence, gate, and guardrail system shall conform to Montage II Welded and Rackable Ornamental Steel, standard picket space, manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

2.02 MATERIAL

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft² (184 g/m²), Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75 x 1.75" x 0.105". Picket holes in the rail shall be spaced 4.715" on center. Fence posts and gate posts shall meet the following minimum size requirements:

Minimum Sizes for Posts			
Fence Posts	Panel Height		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
Gate Leaf	Gate Height		
	Up to 4'	> 4' to 6'	> 6' to 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.

2.03 FABRICATION

- A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly.
- C. The manufactured panels and posts shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic in the following table which meets or exceed the coating performance criteria of ASTM F2408.

Coating Performance Requirements		
Quality		
Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).

Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60-inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Commercial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement. Adjust and maintain spring hinges per 11B-404.2.8.2, so that from the open position of 70 degrees, the gate shall move to the closed position in 1.5 seconds minimum.

PART 3 EXECUTION

3.01 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 FENCE INSTALLATION

- A. Fence post shall be spaced according to the following table, plus or minus 1/2". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth as shown on the drawings. The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

Span	8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Universal		Flat Mount (BB301)		Swivel (BB304)*	
	2.5" (BB302)					
	3" (BB303)					
Post Settings ± 1/2" O.C.	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel.

3.03 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces:

1. Remove all metal shavings from cut area.
2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
3. Apply 2 coats of custom finish paint matching fence color.
4. Failure to seal exposed surfaces per steps 1-3 above will negate warranty.
5. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray.
6. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION

- A. Pedestrian gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

END OF SECTION

**SECTION 32 3119
DECORATIVE METAL FENCES AND GATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative metal fences and gates.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this Section; require attendance by all affected installers.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
 - 2. Shop Drawings:
 - a. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- B. Informational Submittals:
 - 1. Manufacturer's Warranty.

1.04 SUSTAINABILITY SUBMITTALS

- A. CAL-Green documentation and verification data as specified in Section 01 8114 - Sustainable Design Requirements - CAL-Green for the following measures:
 - 1. 5.504.4.1 Adhesives and sealants.
 - 2. 5.504.4.3 Paints and coatings.
 - 3. 5.504.4.3.1 Aerosol paints and coatings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Gates: Gates must comply with CBC 11B-4.
 - 1. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC Section 11B-404.
 - 2. The clear opening width for a gate shall be 32 inches (812.80 mm) minimum. For a swinging gate it shall be measured between the face of the gate and the stop, with the gate open 90 degrees. There shall be no projections into it below 34 inches (863.60 mm) and 4 inches

(101.6 mm) maximum projections into it between 34 inches (863.60 mm) and 80 inches (2032 mm) above the finish floor or ground. gate closers and stops shall be permitted to be 78 inches (1981.20 mm) minimum above the finish floor or ground. CBC Section 11B-404.2.3

3. Handles, pulls, latches, locks, and other operable parts on accessible gates shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34 inches (863.60 mm) minimum and 44 inches (1117.60 mm) maximum above finish floor or ground. Where sliding gates are in the fully open position, operating hardware shall be exposed and usable from both sides. CBC Section 11B-404.2.7.
4. The force for pushing or pulling open a gate shall be as follows: CBC Section 11B-404.2.9.
 - a. Interior hinged gates, sliding or folding gates, and exterior hinged gates: 5 pounds (22.2 N) maximum. Required fire gates: the minimum opening force allowable by the DSA authority, not to exceed 15 pounds (66.7N) . These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the gate in a closed position.
 - b. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4 .
5. Gate closing speed shall be as follows: CBC Section 11B-404.2.8
 - a. Closer shall be adjusted so that the required time to move a gate from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum .
 - b. Spring hinges shall be adjusted so that the required time to move a gate from an open position of 70 degrees to the closed position is 1.5 seconds minimum.
6. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met: (Such conditions must be clearly demonstrated and indicated in the specifications).
 - a. Such hardware has a 'dogging' feature.
 - b. It is dogged during the time the facility is open.
 - c. Such 'dogging' operation is performed only by employees as their job function (nonpublic use).
7. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2 inch (12.70 mm) of the (face of) gate to prevent catching on the clothing or persons. California Referenced Standards code. T-24 Part 12, Section 12-10-202, Item (F).
8. Swing doors and gate surfaces within 10 inches (254.00 mm) of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16 inch (1.58 mm) of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. CBC Section 11B-404.2.10.

2.02 FENCES

- A. Steel
 1. Plates, Shapes, and Bars: ASTM A36/A36M.
 2. Tubing: ASTM A500/A500M, cold-formed steel tubing.
 3. Uncoated Steel Sheet: Hot-rolled steel sheet, ASTM A1011/A1011M, Structural Steel, Grade 45.
 4. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- B. Aluminum: ASTM B221.
 1. Perforated aluminum plate. Refer to Drawings for size, thickness, and perforation pattern.
- C. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
 1. Tamper-proof security bolts.
 2. Self-drilling hex-head screws.

- D. Hinges: Finished to match fence components.
 1. Brackets: Square.
 2. Mounting: Center.
 3. Closing: Self.

2.03 GATES

- A. Manual Swing Gates:
 1. Gate Configuration: As indicated on Drawings.

2.04 SWING GATES

- A. Gate Configuration: As indicated on Drawings.
- B. Gate Frame Height: As indicated on Drawings.
- C. Gate Opening Width: As indicated on Drawings.
- D. Hardware: Refer to Section 08 7100 - Door Hardware.
- E. Cane Bolts: Fabricated from 1/2 inch (12.7 mm) diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in closed position.
- F. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

2.05 MATERIALS

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
- B. Steel
 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
 3. Uncoated Steel Sheet: Hot-rolled steel sheet, ASTM A 1011/A 1011M, Structural Steel, Grade 45.
 4. Woven Wire Cloth: Steel, ASTM E 2016.
- C. Aluminum: ASTM B221.
 1. Extruded Bar and Shape: ASTM B221, 6063-T6.
 2. Sheet: ASTM B209, 3003 or 5005, thickness as required for purposed intended.
 3. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
 4. Extrusions: 6005-T5 alloy.
- D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
 1. Tamper-proof security bolts.
 2. Self-drilling hex-head screws.
- E. Concrete: Type specified in Section 03 3000.
- F. Isolation Strips: Self-adhesive rubber, 30 to 60 mils thick, black.

2.06 MATERIALS - STEEL

- A. General: Comply with recycled content product requirements specified in Section 01 8114.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.

- D. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed.
- E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- F. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
 - 1. Tamper-proof security bolts.
 - 2. Self-drilling hex-head screws.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.07 MATERIALS - ALUMINUM

- A. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
 - 1. Thickness, size, and perforation pattern as indicated on Drawings.
- B. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

2.08 COATING MATERIALS

- A. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of SCAQMD 1113 and Cal GREEN Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. Cal-GREEN Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- B. Isolation Coating: Manufacturer's standard alkali-resistant coating, bituminous paint, or epoxy coating.

2.09 FABRICATION

- A. General: Fabricate fences to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Weld joints of assembly with welds all around, to produce joints of full-member-strength, with no possible moisture penetration.
- C. Grind welds reasonably smooth, but not necessarily flush. Prefabricate units in plant by welding, to the greatest extent possible.
- D. Provide bolted connections for bracing elements and similar parts, but only to extent units must be disassembled for delivery to project and for installation by method indicated.
- E. Assemble fences and gates in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.10 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.11 FINISHES

- A. Paint Maximum Product Emissions Limits: Top coat and primer interior paints must meet current requirements for VOC (Volatile Organic Compounds) limits of SCAQMD 1113 and Cal GREEN Table 5.504.4.3 for VOC Content Limits for Architectural Coatings.
 - 1. Cal-GREEN Requirements for typical paint coatings:
 - a. Primers, Sealers, and Undercoaters: 100 grams per liter of product minus water.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Surface Preparation: Clean surfaces according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- E. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.12 STEEL FINISHES

- A. Surface Preparation: Comply with SSPC-SP 1; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust from uncoated steel; comply with SSPC-SP 5.
- B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.
- C. Factory Prime: Apply shop primer to prepared surfaces of items where field painting after installation indicated, unless indicated otherwise..
- D. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils (0.038 mm).
 - 1. Provide powder coating complying with AAMA 2603.
 - 2. Color and Gloss: As indicated on Drawings.

2.13 ALUMINUM FINISHES

- A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As indicated on Finish Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

- A. Set fence posts in accordance with the manufacturer recommended spacing.
- B. Install in accordance with approved shop drawings.
- C. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6.3 mm).
- B. Maximum Offset From Indicated Position: 1 inch (25.4 mm).

3.05 CLEANING

- A. Leave immediate work area neat at end of work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 32 3300
SITE FURNISHINGS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. All site furnishings, equipment, and accessories indicated on the drawings and/or herein specified, including all footings, anchorages, frames and accessories required to provide complete, safe and usable furnishings to the satisfaction of the Architect.
- B. Shop prime coat, painting and galvanized finishes for all metal and wood not having factory finishes.

1.02 RELATED WORK:

- A. Section 32 1313 - Site Concrete
- B. Section 06 2013 - Exterior Finish Carpentry

1.03 REFERENCES AND STANDARDS

- A. Section 05 5000 - Metal Fabrications
- B. American Society for Testing and Materials, (ASTM).
- C. Manufacturer's printed specifications, instructions and shop details for installation of the indicated and /or specified site and street furnishings.
- D. Standard Specifications: where referred to in these specifications, "State Specifications" shall mean the California CalTrans Specifications, latest edition.

1.04 QUALITY ASSURANCE

- A. Site and Street Furnishings work shall comply with these specifications and all applicable sections of the above-named References and Standards.

1.05 SUBMITTALS

- A. Submit manufacturer's product data, specifications, and installation instructions and shop details for factory fabricated items.
 - 1. Tables
 - 2. Benches
 - 3. Storage Cabinets
 - 4. Play Houses
 - 5. Planting Troughs
 - 6. Worm Composter
 - 7. Bike Racks
 - 8. Bike Lockers
 - 9. Field Boulders (Pictures)
 - 10. Worm Composter
- B. Submit shop drawings. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
- C. Submit samples of selected colors and finishes.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle furnishings to prevent damage and deterioration.
- B. Stack assembled items off the ground.

1.07 PROJECT CONDITIONS

- A. Coordinate work with trades furnishing adjacent work related to site and street furnishings installation.
- B. Provide sleeves, anchors, inserts, bolts, clips, and other items furnished under this Section and built in with work of other trades.
- C. No work shall be installed until shop drawings for the work have been reviewed and approved in writing by the Architect, and final grading and surfacing is completed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Refer to the drawings for Manufacturers and Site and Street Furnishings model numbers.
- B. Concrete: ASTM C94 ready mixed concrete, minimum 28-day compressive strength of 2,500 psi, air-entrained 2% to 4%.
- C. Sleeves for embedded items: Schedule 40 galvanized steel pipe.
- D. Grout: CE CRD C588, non-shrink, non-ferrous type; Master Builder's "EMBECO" or equal.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the substrate under which site and street furnishings are to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide footings, sleeves, frames and anchorages. Furnish templates, setting drawings, and instructions for installation of sleeves and anchorages built into other work.
- B. Locate and layout all furniture, accessories and equipment items. Obtain the Architect's written approval of the layout prior to installation.

3.03 BOULDERS

- A. Install boulders of sizes, types and locations indicated on the drawings.
- B. Use all necessary cranes, slings, and other equipment required to safely set the boulders without damaging surfaces.
- C. Set boulders at the direction of the Landscape Architect.
- D. Damaged boulders shall be replaced at the contractor's expense.

3.04 INSTALLATION

- A. Assemble and install site furnishings in accordance with approved shop drawings and manufacturer's printed instructions.
- B. Perform fitting required for installation. Set the work accurately in location, alignment, and elevation free of rack, measured from established lines and levels. Assembled furnishings shall be firm, rigid, free of rattle, and provide maximum protection against tampering and vandalism.
- C. Minimum concrete footings for embedded metal bench and litter unit posts: 18" diameter x 2'-6" deep.
 - 1. Where footing is in paving, the paving shall cover the footing.

2. Where the footing is free standing, neatly form with sono-tubing and taper 1/4" away from post.

D. Litter receptacles: install a plastic liner in each unit; turn over the balance of the specified liners to the Owner.

3.05 CLEANING

A. Perform cleaning during installation and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair any damage to adjacent work resulting from site and street furnishings work.

B. Upon completion of installation, clean factory-finished items in accordance with manufacturer's cleaning instructions. Exercise care to avoid damage to the finish coating.

END OF SECTION

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**SECTION 32 8400
IRRIGATION SYSTEM**

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Order and furnish all labor, materials, supplies, tools and transportation and perform all operations in connection with and reasonably incidental to complete installation of the automatic sprinkler irrigation systems as shown on the drawings.
1. Trenching, stockpiling, excavation, backfill materials and refilling trenches.
 2. Furnishing materials and installation for complete system including piping, backflow prevention assembly, valves, fittings, sprinkler heads, automatic controls and final adjustment of heads to insure complete and uniform coverage.
 3. Line voltage connections to the irrigation controllers and low voltage control wiring from controllers to remote control valves.
 4. Replacement of unsatisfactory materials.
 5. Clean-up, inspection and approval.
 6. All work of every description mentioned in the specification and/or addenda thereto, and all other labor, and materials reasonably incidental to the satisfactory completion of the work, including clean-up of the site, as directed by the Architect.
 7. Tests.
 8. Record drawings.
- B. Work not included.
1. Irrigation water stub-out
 2. 120 volt A.C. electrical stub-out to controller location.
- C. Where new paving and/or other improvements change the shape and /or size of existing planters, Contractor shall modify existing irrigation to provide complete and uniform coverage of the remaining landscape. Modification to the existing irrigation systems shall use equipment matching the existing equipment: spray irrigation with spray irrigation, drip irrigation with drip irrigation, etc.

1.02 GENERAL REQUIREMENTS

- A. OSHA Compliance: All articles and services covered by this specification shall meet or exceed the safety standards established under the Federal Occupational Safety and Health Act of 1970, together with all amendments in effect as of the date of this specification.
- B. Codes and Standards: Comply with all applicable codes and standards.
1. All work and materials shall be in full accordance with the latest rules and regulations of the National Electric Code; the Uniform Plumbing Code, published by the Western Plumbing Officials Association; and other State or local laws or regulations. Nothing in these Drawings or Specifications is to be construed to permit work not conforming to these codes.
 2. When the Specifications call for materials or construction of a better quality or larger size than required by above-mentioned rules and regulations, the provision of the Specifications shall take precedence over the requirements of the said rules and regulations.
 3. The Contractor shall furnish without any extra charge any additional material and labor when required by the compliance with these rules and regulations, though the work may not be mentioned in these particular Specifications or shown on the Drawings.
 4. The Contractor shall erect and maintain barricades, guards, warning signs, and lights as necessary or required by OSHA regulations for the protection of the public or workers.
 5. Any existing buildings, equipment, piping, pipe covering sewers, sidewalks, landscaping, etc., damaged by the Contractor during the course of this work shall be replaced or repaired by the Contractor in a manner satisfactory to Architect and at Contractor's expense, and before final payment is made. The Contractor shall be responsible for damage caused by

leaks in the piping systems being installed or having been installed by him. He shall repair, at his own expense, all damage so caused, in a manner satisfactory to Architect.

6. The Contractor shall pay for all permits, licenses, and fees required.

1.03 SUPERVISION AND WORKMANSHIP

- A. The Contractor, personally or through an authorized and competent representative, shall supervise the work constantly, and shall as far as possible keep the same foreman and workers on the job from commencement to completion. The workmanship of the entire job must in every way be first class, and only experienced and competent workers will be allowed on the job.

1.04 LAYOUT OF WORK

- A. The Contractor shall stake out the irrigation system as shown on the Drawings. These areas shall be checked by the Contractor and Architect before construction is started. Any changes, deletions or additions shall be determined at this check.

1.05 INSTRUCTION

- A. After the system has been installed and approved, Contractor shall instruct the Owner's Representative in complete operation and maintenance of the irrigation system

1.06 SUBMITTAL

- A. Submit catalog information on all materials which are to be used in the installation. Product and specified options must be highlighted on the catalog information. No substitution will be permitted without prior written approval by the Irrigation Consultant. Complete submittal approval must be obtained prior to construction.
- B. Record Drawings:
 1. The Contractor shall maintain in good order in the field office one complete set of black line prints of all sprinkler drawings which form a part of the contract, showing all water lines, sprinklers, valves, controllers and stub-outs. In the event any work is not installed as indicated on the Drawings, such work shall be corrected and dimensioned accurately from the building walls.
 2. All underground stub-outs for future connections and valves shall be located and dimensioned accurately from building walls on all record drawings.
 3. Upon completion of the work, obtain reproducible prints from Architect and neatly correct the prints to show the as-built conditions.

PART 2 MATERIALS

2.01 PIPE AND FITTINGS

- A. Mainlines (constant pressure) shall be polyvinylchloride (PVC) 1120- Schedule 40 plastic pipe with Schedule 80 solvent-weld fittings.
- B. Lateral lines (non-pressure): 3/4" and larger shall be 1120-Schedule 40 PVC plastic pipe. All lateral lines shall be connected with Schedule 40, Type 1, Grade 1, PVC solvent weld fittings.
- C. Connections between mainlines and RCVs shall be of Schedule 80 PVC (threaded both ends) nipples and fittings.
- D. Risers shall be as follows: Schedule 80 PVC threaded nipples and Schedule 40 PVC ells as shown in the construction details. Offset risers shall be King Bros. model FR-500 flex-risers.

2.02 BACKFLOW PREVENTION DEVICE

- A. Backflow prevention device shall be the reduced pressure type with gate valves, check valves, test cocks, reduced pressure chamber and air vent. Install 12" above finish grade.

2.03 FLOW SENSOR

- A. Flow sensor shall be Creative Sensor Technology as listed on the Drawings.

2.04 GATE VALVES

- A. 2 1/2" and smaller shall be bronze construction with operating wheel and screwed connections. Install in 9" diameter plastic valve box as detailed.

2.05 PRESSURE GAUGES

- A. Pressure gauges shall be hermetically sealed, water tight, dust proof, with shatterproof face (2" diameter) and 1/4" standard pipe thread brass connection. Irro-meter model 7-100 or approved equal.

2.06 QUICK COUPLING VALVES

- A. Quick coupling valves shall be as listed on the Drawings.

2.07 REMOTE CONTROL VALVES

- A. Remote control valves shall be globe pattern with plastic body and bonnet, flow stem and manual bleed petcock. Sizes of remote control valves shall be as listed on the Drawings.

2.08 BOXES FOR REMOTE CONTROL VALVES

- A. Rain Bird VB black plastic valve box with black plastic lid. Lid shall be marked: "Irrigation Control Valve".

2.09 FILTER

- A. Emitter filter shall be part of drip valve assembly as listed on the Drawings.

2.10 CONTROLLER

- A. The standard centralized irrigation system controller shall be the *Rainmaster*® Evolution™ DX3 Central Control System currently utilized by the district. The controller shall have enough stations to control all valves indicated on the Plans including those designated for future extensions, plus a minimum of two spare stations.
- B. Cabinet: The cabinet for the centralized irrigation system controller and components shall be a vandal and weather-resistant stainless steel pedestal cabinet with integral locking mechanism. The cabinet shall fully enclose all controller components, accessories and terminal connections. For irrigation systems which utilize reclaimed water, an adhesive- backed sticker with purple background and white letters shall be placed on the inside cabinet door. The CONTRACTOR shall provide one of the following cabinets.
 1. V.I.T. Products, Inc., Strong Box® Model SB-16SS.
 2. Rainmaster® Evolution™ stainless steel pedestal enclosure.
 3. Approved equal.
- C. Communication Accessories: The centralized irrigation system controller must be equipped with cellular communication accessories capable of remote data transmitted with the *Rainmaster*® Evolution™ DX3 Central Control System.

2.11 CONTROL WIRE, DECODERS AND GROUNDING

- A. Control wire shall be copper with U.L. approval for direct burial in ground, size #14-1. Common ground wire shall have white insulating jacket; control wire shall have insulating jacket of color other than white. Splices shall be made with TW-SPLICE 14 seal packs.
- B. Decoders and grounding plates shall be per Drawings and *Rainmaster*® specifications.

2.12 RAIN SWITCH

- A. Rain switch shall be as listed on the Drawings.

2.13 SPRINKLER HEADS

- A. All sprinkler heads shall be as listed on the Drawings.

2.14 SUB-SURFACE DRIP

- A. Sub-surface drip irrigation shall be Rain Bird XFS-CV dripline, flush valves, air-vacuum relief valves, fittings and all other components specified and detailed on the drawings.

2.15 MISCELLANEOUS INSTALLATION MATERIALS

- A. Solvent cement and primer for solvent weld joints shall be of make and type approved by manufacturer(s) of pipe and fittings. Cement shall be maintained at proper consistency throughout use.
- B. Pipe joint compound shall be non-hardening, non-toxic materials designed specifically for use on threaded connections in water carrying pipe. Performance shall be same as Permatex No. 51.

2.16 MISCELLANEOUS EQUIPMENT

- A. Provide all equipment called for by the Drawings.
- B. Provide to the Owner, at completion of Maintenance Period, three (3) each of all operating and servicing keys and wrenches required for complete maintenance and operation of all heads and valves. Include all wrenches necessary for complete disassembly of all heads and valves.

PART 3 INSTALLATION

3.01 PREPARATION

- A. Schedule and coordinate placement of materials and equipment in manner to effect the earliest completion of work in conformance with construction and progress schedule.

3.02 HANDLING AND STORAGE

- A. Protect work and materials from damage during construction and storage as directed by Architect.
- B. Handle plastic pipe carefully; especially protect it from prolonged exposure to sunlight.

3.03 LAYOUT

- A. Lay out work as accurately as possible in accordance with diagrammatic drawings.
- B. Where site conditions do not permit location of piping, valves and heads where shown, notify Architect immediately and determine relocation in joint conference.
- C. Run pipelines and automatic control wiring in common trenches wherever practical.

3.04 EXCAVATION AND TRENCHING

- A. Excavation shall be in all cases ample in size to permit the pipes to be laid at the elevations intended and to permit ample space for joining.
- B. Make trenches for pipelines deep enough to provide minimum cover from finish grade as follows:
 1. 18" minimum cover over mainlines to control valves and quick coupling valves.
 2. 18" minimum cover over control wires from controller to valves.
 3. 12" minimum cover over RCV controlled lateral lines to sprinkler heads.
 4. 4" cover over drip tubing.

- C. Restore surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to original conditions in manner approved by Architect.
- D. Where other utilities interfere with irrigation trenching and pipe work, adjust the trench depth as instructed by Architect.

3.05 ASSEMBLING PIPELINES

- A. All pipe shall be assembled free from dirt and pipe scale. Field cut ends shall be reamed only to full pipe diameter with rough edges and burrs removed.
- B. Solvent Weld Joint:
 1. Prepare joint by first making sure the pipe end is square, then deburring the pipe end and cleaning pipe and fitting of dirt, dust, and moisture.
 2. Dry-insert pipe into fitting to check for missizing. Pipe should enter fitting 1/3 to 2/3 depth of socket.
 3. Coat the inside socket surface of the fitting and the fitting and the male end of the pipe with P-70 primer (manufactured by Weld-On). Then without delay, apply Weld-On 711 cement liberally to the male end of the pipe and also apply Weld-On 711 cement lightly to the inside of the socket. At this time, apply a second coat of cement to the pipe end.
 4. Insert pipe immediately into fitting and turn 1/4 turn to distribute cement and remove air bubbles. The pipe must seat to the bottom of the socket and fitting. Check alignment of the fitting. Pipe and fitting shall be aligned properly without strain to either.
 5. Hold joint still for approximately thirty (30) seconds and then wipe the excess cement from the pipe and fitting.
 6. Cure joint a minimum of thirty (30) minutes before handling and at least six (6) hours before allowing water in the pipe.
- C. Threaded Joint:
 1. Field threading of plastic pipe or fittings is not permitted. Factory-formed threads only will be permitted.
 2. Factory-made nipples shall be used wherever possible. Field-cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on axis with sharp dies.
 3. All threaded joints shall be made up with pipe joint compound. Apply compound to male threads only.
 4. Where assembling metallic pipe to metallic fitting or valve, no more than three (3) full threads shall show when joint is made up.
 5. Where assembling to threaded plastic fitting, take up joint no more than one full turn beyond hand tight.
 6. Where assembling soft metal (brass or copper) or plastic pipe, use strap type friction wrench only; do not use metal-jawed wrench.
- D. Connection at Drip Tubing:
 1. Connections shall be made with fittings specifically designed for use with Rain Bird XFS-CV drip tubing. Follow manufacturer's requirements for installation.
- E. Cap or plug openings as pipeline is assembled to prevent entrance of dirt or obstructions. Remove caps or plugs only when necessary to continue assembly.
- F. Where pipes or control wires pass through sleeves, provide removable non-decaying plug at ends of sleeve to prevent entrance of earth.

3.06 REMOTE CONTROL VALVES

- A. Install where shown on Drawings and group together where practical. Limit one remote control valve per box – No Exceptions.
- B. Locate valve boxes 12" from and perpendicular to walk edges, buildings, and walls. Provide 12" between valve boxes where valves are grouped together.

- C. Thoroughly flush mainline before installing valve.
- D. Install in shrub or ground cover areas where possible.
- E. Label control line wire at each valve with a 2 1/4" x 3/4" polyurethane I.D. tag, indicating identification number of valve (controller and station number). Attach label to control wire.
- F. Install decoders per manufacturer's instructions.

3.07 AUTOMATIC CONTROL WIRE

- A. Run lines along mains wherever practical. Tie wires in bundles with pipe wrapping tape at 10' intervals and allow slack for contraction between strappings.
- B. Loop a minimum of three (3) feet of extra wire in each valve box; both control wire and ground wire.
- C. Connections shall be made by crimping bare wires with brass connectors and sealing with 3M DBR/Y-6 sealer packs.
- D. Splicing will be permitted only on runs exceeding 2500'. Locate all splices at valve locations within valve boxes.
- E. Where control lines pass under paving, they shall pass through Schedule 40 electrical PVC conduit.
- F. Install wire, decoders, grounding, etc. in strict accordance with manufacturer's two-wire installation instructions.

3.08 AUTOMATIC CONTROLLER

- A. Provide and install automatic irrigation controller in approximate locations shown on Drawings. The exact location will be determined on the site by Architect. Provide conduit and wire and connect to 120 volt switch accessible to controller for ease of maintenance.
- B. Connect control lines to controller in sequential arrangement according to assigned identification number of valve. Each control line wire shall be labeled at controller with a permanent non-fading label indicating station number of valve controlled. Attach label to control wire.
- C. Provide, program and install *Rainmaster*® decoders for two-wire control system.

3.09 SPRINKLER HEADS AND QUICK COUPLING VALVES

- A. Thoroughly flush lines before installing heads or QCVs.
- B. Locate heads and QCVs as shown in the Drawings and Details.
- C. Adjust sprinkler heads for proper distribution and trim.

3.10 DRIPLINE AND FITTINGS

- A. Install as indicated on the Drawings.
- B. Install tubing at a uniform depth of 4 inches.
- C. Use only special tools manufactured or recommended by the drip equipment manufacturer for installation of tubing and fittings.
- D. Thoroughly flush lines.

3.11 TESTING

- A. Perform test as specified below. Remake any faulty joints with all new materials. Use of cement or caulking to seal leaks is absolutely prohibited. The Contractor shall:
 1. Notify Architect at least three (3) days in advance of testing.

2. Perform testing at his own expense.
3. Center load piping with small amount of backfill to prevent arching or slipping under pressure. No fitting shall be covered.
4. Apply the following tests after weld plastic pipe joints have cured at least 24 hours.
 - a. Test live (constant pressure) and QCV lines hydrostatically at 125 PSI minimum. Lines will be approved or not approved as such results may indicate. The Contractor shall make tests and repairs as necessary until test conditions are met.
 - b. Test RCV controlled lateral lines with water at line pressure and visually inspect for leaks. Retest after correcting defects.

3.12 BACKFILLING

- A. Backfill only after piping has been tested, inspected and approved.
- B. Backfill material shall be the earth excavated from the trenches, free from rocks, concrete chunks, and other foreign or coarse materials. Carefully select backfill that is to be placed next to plastic pipe to avoid any sharp objects which may damage the pipe.
- C. All pipe under asphalt paving shall be backfilled with 4" of clean sand on all sides of pipe.
- D. Place backfill materials in 6" layers and compact by jetting or tamping to a minimum compaction of 90 percent of original soil density.
- E. Dress off areas to finish grades and remove excess soil, rocks or debris remaining after backfill is completed.
- F. If settlement occurs along trenches, and adjustments in pipes, valves and sprinkler heads, soil, sod or paving are necessary to bring the system, soil, sod or paving to the proper level or the permanent grade, the Contractor, as part of the Work under this contract, shall make all adjustments without extra cost to the Owner.

3.13 GUARANTEE

- A. It shall be the responsibility of the Contractor to fill and repair all depressions and replace all necessary lawn and planting due to the settlement of irrigation trenches for one year following completion and acceptance of the job.
- B. The Contractor shall also guarantee all materials, equipment and workmanship furnished by him to be free of all defects of workmanship and materials, and shall agree to replace at his expense, at any time within one year after installation is accepted, any and all defective parts that may be found.

3.14 CLEAN-UP

- A. Clean-up shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down, and any damage sustained on the work of others shall be repaired to original conditions.

3.15 FINAL REVIEW PRIOR TO ACCEPTANCE

- A. Operate each system in its entirety at time of final review. Any items deemed not acceptable shall be reworked to the satisfaction of the irrigation consultant. Contact Landscape Architect at least 3 working days prior in advance to coordinate inspection.
- B. Final review shall take place after submission of all specified lists, record drawings, and manuals.
- C. Prior to approval of recycled water service, the prevailing water district shall perform a system inspection and cross connection test. Contractor shall assist the District inspector as necessary during the inspection and make necessary corrections to the irrigation systems as identified by the inspector.

3.16 INSPECTIONS

- A. The contractor shall be subject to inspections at any and all times by authorized representatives of the Owner.

3.17 MAINTENANCE

- A. The contractor is to make all repairs and maintain the entire sprinkler system from the times of installation through the landscape maintenance period.

END OF SECTION

GUARANTEE FOR IRRIGATION SYSTEM

WE HEREBY GUARANTEE THAT THE IRRIGATION SYSTEM WE HAVE FURNISHED AND INSTALLED IS FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP, AND THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. WE AGREE TO REPAIR OR REPLACE ANY DEFECTS IN MATERIAL OR WORKMANSHIP, ANY SETTLING OF BACKFILLED TRENCHES, WHICH MAY DEVELOP DURING THE PERIOD OF ONE YEAR FROM DATE OF ACCEPTANCE AND ALSO TO REPAIR OR REPLACE ANY DAMAGE CAUSED BY ANY DEFECTS IN THE IRRIGATION SYSTEM OR RESULTING FROM THE REPAIRING OR REPLACING OF SUCH DEFECTS AT NO ADDITIONAL COST TO THE OWNER. ORDINARY WEAR AND TEAR, UNUSUAL ABUSE OR NEGLIGENCE ARE EXCEPTED. WE SHALL MAKE SUCH REPAIRS OR REPLACEMENTS, INCLUDING COMPLETE RESTORATION OF ALL DAMAGED PLANTING, PAVING, OR OTHER IMPROVEMENTS OF ANY KIND, WITHIN A REASONABLE TIME, AS DETERMINED BY THE OWNER, AFTER RECEIPT OF WRITTEN NOTICE. IN THE EVENT OF OUR FAILURE TO MAKE SUCH REPAIRS OR REPLACEMENTS WITHIN A REASONABLE TIME AFTER RECEIPT OF WRITTEN NOTICE FROM THE OWNER, WE AUTHORIZE THE OWNER TO PROCEED TO HAVE SAID REPAIRS OR REPLACEMENTS MADE AT OUR EXPENSE AND WE WILL PAY THE COSTS AND CHARGES THEREFORE UPON DEMAND.

PROJECT: _____

LOCATION: _____

CONTRACTOR: _____

LICENSE NO: _____

ADDRESS: _____

TELEPHONE: _____

GUARANTEE TO: _____

DATE OF ACCEPTANCE: _____

AUTHORIZED REPRESENTATIVE: _____

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SECTION 32 9110**TOPSOIL****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Scarification of Subgrade
- B. Installation of topsoil from site stockpiles
- C. Installation of clean topsoil next to the building or paving that has been treated with lime required to complete the work.

1.02 RELATED SECTIONS

- A. Section 31 2000 – Earth Moving
- B. Section 32 9219 – Hydroseeding
- C. Section 32 9223 – Sodding
- D. Section 32 9300 – Planting

1.03 REFERENCES

- A. USDA Handbook No. 60

1.04 DEFINITIONS

- A. Existing Soil: Area of undisturbed native soil where no rough grading is to be performed. Surface cultivation and soil amending are included in this Section. See Drawings.
- B. Subgrade: Soil level resulting from the rough grading work under another Section. Cultivation of all subgrade areas prior to placement of topsoil is included in this Section.
- C. Topsoil: Soil stockpiled for spreading over prepared subgrade.
 - 1. Stockpiled Native Topsoil: Topsoil stripped from the site prior to rough grading work under another Section, to be spread and amended as work under this Section.
 - 2. Imported Topsoil: Off-site topsoil imported and stockpiled under this Section, to be spread and amended as work under this Section.

1.05 QUALITY ASSURANCE

- A. Provide written laboratory tests on any required import topsoil, prepared by a reputable firm experienced in the field of soils and plant nutrition.
- B. All tests will be paid for by the Owner, but the cost of retesting of topsoil required because of rejected topsoil submittals will be deducted from the amount due the Contractor under this Section.

1.06 SUBMITTALS

- A. Soil analysis reports
 - 1. Test the following soils:
 - a. Existing topsoil remaining in situ.
 - b. Stockpiled native topsoil.
 - 2. Soils analysis report through Waypoint Analytical Laboratory Inc, 1101 S. Winchester Blvd, Suite G-173, San Jose, CA 95128 Tel (408) 727-0330 or equal. The soil laboratory must be Seal of Testing Certified. Analyses are to be obtained at Contractor's cost and are to include:
 - a. A05-2 Analysis Report to include amendment recommendations based on an "organic" approach to soil and landscape management. A05-2 requires a 4-cup sample.

- 1) Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner.
 - 2) Test for agricultural suitability, parasitic nematodes and herbicide contamination.
 3. Existing and stockpiled topsoil shall be amended per soils analysis report.
- B. Fertilizers and amendments as required through the Soil analysis report and per Sections 32 9219, 32 9223, and 32 9300.

1.07 PROJECT CONDITIONS

- A. Do not do subgrade preparation, or topsoil installation until construction work is completed in the area to be planted and the subgrade for topsoil is approved by the Architect.
- B. Protect utilities, paving, and other structures from damage caused by topsoil operations.
- C. Do not purchase or deliver any required import topsoil to the site without the written approval of the proposed topsoil by the Architect

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Stockpiled Native Topsoil:
1. Quantity: The approximate quantity of stockpiled native topsoil will not be known until the demolition and rough grading have been completed under Civil work.
 2. Stockpiling: Stripped topsoil shall have been stockpiled on the site.
 3. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over 1 inch in diameter, sticks, oils, chemicals, plaster, concrete and other deleterious materials.

2.02 EXCESS TOPSOIL

- A. If more topsoil has been stockpiled on the site than is required to complete the work as indicated on the Drawings, dispose of the excess topsoil on the site at the direction of the Owner at no additional cost to the Owner.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.03 SUBGRADE PREPARATION

- A. Grades:
1. Subgrades have been established under work of another Section to within 1 inch, plus or minus, of required grades. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.
 2. Verify that subgrades are within 1" plus or minus, of required subgrades.
- B. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory, or assume responsibility for conditions as they exist.

- C. Weed and Debris Removal: All ground areas to receive topsoil shall be cleaned of all weeds and debris prior to any subgrade preparation or topsoiling. Weeds and debris shall be disposed of off the site.
- D. Do not perform any subgrade preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- E. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- F. Soil Loosening: Soil subgrade in all areas to receive topsoil shall be ripped or cultivated to the depths specified below. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed from the site.
 - 1. All areas that are to be topsoiled shall be ripped or cultivated 8 inches deep.

3.04 INSTALLATION OF TOPSOIL

- A. Do not install topsoil until preparation of subgrade has been approved by the Architect.
- B. Moisture Content: Do not work topsoil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.
- C. Remove noxious weeds, rocks over 2 inches in diameter, and debris from topsoil, and dispose of off the site.
- D. Remove all lime treated soil in all plant areas next to the newly constructed building and paving to a depth of three feet and dispose of off the site.
- E. Fertilize and amend the soil as required by the Soil Analysis Report. If such a report is not available at the time of bidding, the following materials shall be used for bidding purposes only:
 - 1. Soil Amendments per 1,000 square feet: Incorporate thoroughly with top six (6) inches of all planting areas: 6 cubic yards organic amendment as specified
- F. Thickness of topsoil, including soil conditioners to be added later under Section 32 9300, shall be 6 inches and grades shall conform to those indicated on the site grading plans and specified herein.
- G. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regarded until the grade of all planting areas conforms with finished grade indicated on the Site Grading Plans to within plus or minus 1".

END OF SECTION

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SECTION 32 9113
IMPORT TOPSOIL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Scarification of Subgrade
- B. Installation of import topsoil
- C. Installation of import vegetable mix in raised planters
- D. Installation of import topsoil next to building that has been treated with lime

1.02 RELATED WORK

- A. Section 31 2000 – Earth Moving
- B. Section 32 9300 – Planting
- C. Section 32 9219 – Hydroseeded Lawn
- D. Section 32 9223 – Sodding

1.03 REFERENCES

- A. USDA Handbook No. 60

1.04 QUALITY ASSURANCE

- A. Provide written laboratory tests on any required import topsoil, prepared by a reputable firm experienced in the field of soils and plant nutrition.
- B. All tests will be paid for by the Owner, but the cost of re-testing of topsoil required because of rejected topsoil submittals will be deducted from the amount due the Contractor under this Section.

1.05 SUBMITTALS

- A. Source of supply of proposed import topsoil types.
- B. Three copies of laboratory tests on the proposed import topsoil and vegetable mix. Fertility determined by pH, salinity, nitrate, ammonium, phosphate, potassium, calcium and magnesium analysis.
 - 1. Agricultural Suitability as determined by pH, salinity, boron, sodium, potassium, calcium and magnesium analyses using USDA saturation extract procedure.
 - 2. Appraisal of the soil type and certain chemical properties provided as pH, salinity, organic matter and particle size distribution (USDA classification).

1.06 PROJECT CONDITIONS

- A. Do not do subgrade preparation, or topsoil installation until construction work is completed in the area to be planted and the subgrade for topsoil is approved by the Architect.
- B. Protect utilities, paving, and other structures from damage caused by topsoil operations.
- C. Do not purchase or deliver any required import topsoil to the site without the written approval of the proposed topsoil by the Architect.

PART 2 PRODUCTS

2.01 IMPORT TOPSOIL

- A. Furnish and install sufficient topsoil to complete the work as indicated on the Drawings and herein specified.
- B. Preselected Topsoil: Sandy Loam, TMT Enterprises, 408.432.9040 or equal.
- C. Agricultural Suitability:

Salinity (ECe x 10(3)):	0-2
Sodium (SAR) 2:	0-8
(ESP) 1:	0-10
Boron (PPM in Saturated Extract):	0- 0.7
pH:	5.5 to 7.5
- D. Soil Type: agricultural sandy loam; maximum 50% clay and silt fines. Meet USDA specifications for the specified texture.
- E. Quality: free of debris, rocks over 2" diameter, noxious weeds and parasitic nematodes.
- F. Should the samples not meet all of the standards given above, the soil laboratory may submit in the report what additives (in addition to those specified in Section 329300) should be added to the soil to correct deficiencies.

2.02 IMPORT TOPSOIL FOR RAISED PLANTER BEDS

- A. Furnish and install sufficient topsoil to complete the work as indicated on the Drawings and herein specified.
- B. Preselected Topsoil: Local Hero Veggie Mix from American Soil & Stone, 510-292-3000 or equal.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.03 SUBGRADE PREPARATION

- A. Grades:
 1. Subgrades have been established under work of another Section to within 1 inch, plus or minus, of required grades. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.
 2. Verify that subgrades are within 1" plus or minus, of required subgrades.
 3. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All ground areas to receive topsoil shall be cleaned of all weeds and debris prior to any subgrade preparation or topsoiling. Weeds and debris shall be disposed of off the site.

- C. Do not perform any subgrade preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- E. Soil Loosening: Soil subgrade in all areas to receive topsoil shall be ripped or cultivated to the depths specified below. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed from the site.
 - 1. All areas that are to be topsoiled shall be ripped or cultivated 8 inches deep.

3.04 INSTALLATION OF TOPSOIL

- A. Do not install topsoil until preparation of subgrade has been approved by the Architect.
- B. Moisture Content: Do not work topsoil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.
- C. Remove noxious weeds, rocks over 2 inches in diameter, and debris from topsoil, and dispose of off the site.
- D. Remove all lime treated soil in all plant areas next to the newly constructed building to a depth of three feet and dispose of off the site.
- E. Fertilize and amend the soil as required by the Soil Analysis Report. If such a report is not available at the time of bidding, the following materials shall be used for bidding purposes only:
 - 1. Soil Amendments per 1,000 square feet: Incorporate thoroughly with top six (6) inches of all planting areas: 6 cubic yards organic amendment as specified
- F. Thickness of topsoil, including soil conditioners to be added later under Section 32 9300, shall be 6 inches and grades shall conform to those indicated on the site grading plans and specified herein.
- G. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regarded until the grade of all planting areas conforms to finished grade indicated on the Site Grading Plans to within plus or minus 1".

END OF SECTION

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**SECTION 32 9219
HYDROSEEDING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Soil preparation, soil conditioning and finished grading
 - 2. Furnish and install hydroseeded lawn
 - 3. Maintenance
- B. Related Sections include the following:
 - 1. Section 32 8400 – Irrigation System
 - 2. Section 32 9110 – Topsoil
 - 3. Section 32 9113 – Import Topsoil

1.03 REFERENCES

- A. United States Department of Agriculture Rules and Regulations - Federal Seed Act.

1.04 QUALITY ASSURANCE

- A. Provide Class A seed complying with the above references, in original unopened containers bearing guaranteed analysis and germination procedures.
- B. Furnish all certificates of inspection that are required by county or state authorities.

1.05 SUBMITTALS

- A. Submit the following material samples:
 - 1. Seed
 - 2. Hydromulch Material
- B. Soils analysis report through Waypoint Analytical Laboratory Inc, 1101 S. Winchester Blvd, Suite G-173, San Jose, CA 95128 Tel (408) 727-0330 or equal. The soil laboratory must be Seal of Testing Certified. Analyses are to be obtained at Contractor's cost and are to include:
 - 1. A05-2 Analysis Report to include amendment recommendations based on an "organic" approach to soil and landscape management. A05-2 requires a 4-cup sample.
 - a. Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Existing soil shall be amended per soils analysis report.
 - 2. Test for parasitic nematodes only if the import soil is from an agricultural source.
 - 3. The soil analysis lab test must be conducted within 120 days prior to the start date of planting.
- C. Submit the following materials certification from approved qualified testing laboratories:
 - 1. Soil conditioners and fertilizers
- D. Submit seed vendor's certification for required grass seed mixture, indicating percentage by weight and percentages of purity, germination and weed seed for each grass species.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver seed, hydromulch materials and fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.
- B. Protect materials in transit and after delivery to the Project site. Materials in broken containers will be rejected. Remove rejected material from the site immediately.

1.07 PROJECT CONDITIONS

- A. Do not do soil preparation, conditioning, and lawn planting until construction work is completed in the area to be planted.
- B. Protect utilities, paving, and other structures from damage caused by lawn planting operations.
- C. The irrigation system shall be installed, tested and approved by the Architect prior to lawn planting.

1.08 WARRANTY

- A. Warrant lawns to germinate, take root and grow, be in a healthy, vigorous condition, providing a uniform, weed free stand of grass with no bare spots, until final acceptance by the Owner.
- B. Inspection of lawn planting will be made by Architect at completion of work.
- C. Replace, in accordance with the drawings and specifications, all lawn that is, as determined by the Architect, in nonconformance with the above warranty.

PART 2 PRODUCTS

2.01 SEED

- A. Quantities: Seed shall be furnished in quantities required to complete work as indicated on the Drawings and shall be of species specified.
- B. Furnish the seed mix specified on the drawings
- C. Nomenclatures: Grass names listed on Drawings conform to standardized plant names established by American Joint Committee on Horticulture Nomenclature, except that for names not covered therein, the established custom of the seed industry is followed.
- D. Quality:
 - 1. Class A, USDA
 - 2. Percentage purity and minimum germination as specified on the drawings.
- E. Substitutions will be allowed only when specified material is proved unavailable and only with the approval of the Architect.

2.02 FERTILIZERS AND SOIL CONDITIONERS

- A. Organic Compost:
 - 1. Gradation: A minimum of 90% of the material by weight shall pass a ½” screen. Material passing the ½” screen shall meet the following criteria:

Percent Passing	Sieve Size
85-100	3/8 inch
50-80	#8 (8 mesh)
0-40	#35 (32 mesh)
 - 2. Organic Content: Minimum 50% based on dry weight and determined by ash method. Minimum 250 lbs organic matter per cubic yard of compost.
 - 3. Carbon to Nitrogen Ratio: Ranges from 15:1 – 35:1.
 - 4. pH: 5.5 – 8.0 as determined in saturated paste.

5. Moisture content: 35-60%
 6. Contaminants: The compost shall be free of contaminants such as glass, metal, and visible plastic.
 7. Maturity: Physical characteristics suggestive of maturity include:
 - a. Color: dark brown to black
 - b. Odor: Acceptable=none, soil-like, musty or moldy
Unacceptable= sour, ammonia or putrid
 - c. Particle characterization: identifiable wood pieces are acceptable, but the balance of material should be soil-like without recognizable grass or leaves.
 8. The compost analysis must be conducted within 120 days prior to the start day of planting.
- B. Fertilizer:
1. Slow-release Fertilizer: Lawn Restore Lawn Fertilizer (10N-2P-6K) available through Peaceful Valley Farm Supply, www.groworganic.com.

2.03 ACCESSORIES

- A. Hydroseed Mulch Materials for Lawns: Wood Fiber for Mulching: Fiber produced from cellulose such as wood pulp or similar organic material approved by the Architect and shall be of such character that it will disperse into a uniform slurry when mixed with water. The fiber shall be of such character that when used in the applied mixture, an absorptive or porous mat, but not a membrane, will result on the surface of the ground. Materials that inhibit germination of growth shall not be present in the mixture. Color - green.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.03 SOIL PREPARATION

- A. Grades:
 1. Grades have been established under work of another Section to within 0.1' plus or minus, of required finished grades.
 2. Verify that grades are within 0.1' plus or minus, of required finished grades.
 3. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All areas to be planted in lawn shall be cleaned of all weeds and debris prior to any soil preparation or grading work. Weeds and debris shall be disposed of off the site. Apply pre-emergence herbicide to the area slated for hydroseeding in accordance with the manufacturer's recommended rates. Any areas of hydroseeded areas showing loss of vigor or health owing to improper application of the herbicide shall be replaced by the Contractor.
- C. Do not perform any soil preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.

- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and hydroseeding.
- E. Soil Loosening:
 - 1. Scope:
 - a. Lawn areas that have topsoil specified: Loosening of subgrade is specified under the Section on top soiling; no additional loosening is required unless, as determined by the Architect, topsoil has become compacted by construction work.
 - b. Loosening where no topsoil is specified: loosen as specified below.
 - 2. Soil Loosening:
 - a. Cultivate soil to depths specified below. Add water as necessary and cultivate in two directions until the entire depth is loose and friable. Remove all debris, base rock, paving and rocks over 2-inches in diameter from the site.
 - b. All lawn areas: 8-inches deep

3.04 SOIL CONDITIONING

- A. General: After soil preparation has been completed and high and low spots graded, add soil amendments as indicated below and rototill, making repeated passes with the cultivator to the depth specified until the amendments have been thoroughly mixed.
- B. Lawn Areas: Rototill the following into the top 5 inches of soil at the specified rates per 1000 square feet of area:
 - 1. Organic Compost: 6 cubic yards (2" layer).
- C. Soil Loosening and Soil Conditioning are separate operations and shall not be combined.

3.05 FINISHED GRADING

- A. When weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled, all lawn areas shall be smooth-graded, ready for hydroseeding.
- B. Grading shall be done when soil is at optimum moisture content for working.
 - 1. Remove rocks 1 inch in diameter and larger
- C. Grades:
 - 1. The Contractor shall make himself familiar with site grading plans and do finished grading in conformance with said plans and as herein specified.
 - 2. Finished grades shown on site grading plans are given in feet and decimal fractions of feet. Slope uniformly between given spot elevations. Lawn areas shall be true to grade with a 10-foot straight edge.
 - 3. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given or between points established by walks, paving, curbs, or catch basins. Finished grades shall be smooth, even, and on a uniform plane with no abrupt change of surface. Minor adjustments of finish grades shall be made at the direction of the Architect, if required.
 - 4. All grades shall provide for natural runoff of water without low spots or pockets. Flow-line grades shall be accurately set and shall not be less than 2-percent gradient wherever possible.
 - 5. Lawn Areas: Finished grade shall be 3/4 inch below top of adjacent pavement, curbs, or headers.
 - 6. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.

3.06 LAWN PLANTING

- A. General:

1. Do not plant lawns until all construction work has been completed and sprinkler systems have been installed and tested. Lawn areas shall have been graded and prepared as herein specified and shall have been approved by the Architect.
 2. Do not plant during unfavorable weather.
 3. Soil shall be at an optimum moisture content for planting. Do not plant in dry soil or muddy soil.
 4. After the areas have been loosened, conditioned, and finish-graded as previously specified, they shall be hand-raked to remove all clods, weeds, roots, debris, and rocks 1-inch in diameter and larger.
 5. After the areas have been prepared, no heavy objects (except lawn rollers) shall be taken over the areas at any time.
 6. Final grades shall be approved by the Architect prior to hydroseeding.
- B. Hydroseeding:
1. Hydromulch: Mix at the following rates:

Fiber	1000 pounds per acre
Lawn Seed	As specified on Drawings
Slow Release Fertilizer	10 pounds per 1000 square feet
 2. Mixing:
 - a. Prepare slurry by mixing fiber, seed, and water in the proportions specified herein. The weights of the various materials to be used in the slurry shall be determined from marked weights per sack and sack count or by weighing on approved scales.
 - b. The materials shall be loaded into the mixer and mixed in such sequence as to provide a thoroughly mixed homogeneous slurry. The slurry shall have the proper consistency to adhere to the earth without lumping or running.
 - c. Mixing time of the materials shall not exceed 45 minutes from the time the seeds come into contact with the water in the mixer to the complete discharge of the prepared slurry onto the earth; otherwise the batch will be rejected.
 3. Application:
 - a. Water prepared lawn areas thoroughly and allow surface to dry off.
 - b. Apply slurry using a method of hydraulic planting approved by the Architect.
 - c. Distribution of the slurry shall be uniform throughout.
 - d. When conditions are such, by reason of high winds, excessive moisture, or other factors, that satisfactory results are not likely to be obtained, the work shall be stopped. The work shall be resumed only when conditions are favorable again.
 4. Reseed at 10-day intervals any areas that do not take root and grow until a uniform stand of grass acceptable to the Architect is established.

3.07 PROTECTION

- A. Protect all lawn areas against trespassing and damage at all times. If any lawn areas are damaged, treat or replace as directed by the Architect, without additional cost to the Owner.
- B. Do not execute work in or over prepared lawn areas or adjacent to planting without proper safeguards and protection.

3.08 GENERAL CLEANUP

- A. Remove all surplus materials, and other debris from site. Neatly dress and finish all lawn areas. Flush walks, paved areas, and the like, clean to the satisfaction of the Architect.
- B. Rinse foliage of any plant materials that have been sprayed with hydromulch material.

3.09 MAINTENANCE

- A. Establishing Maintenance Period:
 1. As soon as all lawn installation is completed, a planting review and preliminary inspection to determine the condition of the lawns will be held by the Architect upon request of the Contractor.
 2. Upon approval of the work by the Architect, the 90-day maintenance period shall begin.

- B. Maintenance of Lawns: Continuously maintain all lawns in areas included in the Contract from the beginning of Contract work, during the progress of work, and for the length of the maintenance period after completion of all work until final acceptance of all Contract work by the Owner.
- C. Scope:
 - 1. New lawns
 - 2. Existing lawns within the construction area.
 - 3. Continuous operations of watering, weeding, mowing, trimming, edging, rolling, fertilizing, spraying, insect, pest, fungus, and rodent control, and any other operations to assure good normal growth.
- D. Fertilizing: In addition to fertilizing of lawns herein specified, furnish and apply any additional fertilizers necessary to maintain plantings in a healthy, green, vigorous growing condition during the maintenance period.
- E. Mowing:
 - 1. Winter: Mow grass to 1-1/2 inches when it reaches a height of 2½ inches.
 - 2. Other seasons: Mow grass to 2-1/2 inches when it reaches a height of 3½ inches.
 - 3. Grass cuttings shall be collected and disposed of off-site (recycled with local composting company).
- F. Weeding and Cleanup: Lawn areas shall be kept neat and free from debris at all times and shall be weeded at not more than 10-day intervals.
- G. Insect, Pest, and Disease Control:
 - 1. Insects and diseases shall be controlled by the use of approved insecticides and fungicides.
 - 2. Moles, gophers, and other rodents shall be controlled by traps, approved pellets inserted by probe gun, or other approved means.
- H. Protection: Work under this Section shall include complete responsibility for maintaining adequate protection for all lawn areas. Any damaged areas shall be repaired at no additional expense to the Owner.
- I. Replacements: Immediately re-seed any lawn areas that die out or are damaged. Replacements shall be made to the Specifications as required for original plantings.
- J. Condition of Lawns at the End of the Maintenance Period:
 - 1. All lawns shall be live, healthy, undamaged, and free from infestations.
 - 2. All lawn areas shall be completely and uniformly covered at the time of final acceptance, leaving no barren spots.
 - 3. Lawns shall be free of all weeds (broadleaf and grass weeds).
 - 4. Lawns that do not conform to Specifications shall be re-seeded and brought to a satisfactory condition before final acceptance of the work can be made.

END OF SECTION

SECTION 32 9223

SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Soil preparation and conditioning
- B. Furnish and install sodded lawn
- C. Maintenance

1.02 RELATED SECTIONS

- A. Section 32 8400 – Irrigation System
- B. Section 32 9110 – Topsoil
- C. Section 32 9113 – Import Topsoil
- D. Section 32 9300 – Planting

1.03 REFERENCES

- A. United States Department of Agriculture Rules and Regulations - Federal Seed Act.
- B. American Sod Producers Association (ASPA) classes of sod materials.

1.04 QUALITY ASSURANCE

- A. Provide Class A sod complying with the above references, grown by a commercial sod nursery.
- B. Furnish all certificates of inspection that are required by county or state authorities.

1.05 SUBMITTALS

- A. Soils analysis report through Waypoint Analytical Laboratory Inc, 1101 S. Winchester Blvd, Suite G-173, San Jose, CA 95128 Tel (408) 727-0330 or equal. The soil laboratory must be Seal of Testing Certified. Analyses are to be obtained at Contractor's cost and are to include:
 - 1. A05-2 Analysis Report to include amendment recommendations based on an "organic" approach to soil and landscape management. A05-2 requires a 4-cup sample.
 - a. Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Existing soil shall be amended per soils analysis report.
 - 2. Test for parasitic nematodes only if the import soil is from an agricultural source.
 - 3. The soil analysis lab test must be conducted within 120 days prior to the start date of planting.
- B. Submit sod grower's certification of grass species. Identify source location.
- C. Submit the following materials certification from approved qualified testing laboratories:
 - 1. Soil conditioners and fertilizers

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver rolls of sod to the site within 24 hours of harvesting. Deliver only as much sod as can be planted on the day of delivery. Remove from the site any sod not complying with the above.
- B. Protection: handle sod so that it is adequately protected at all times from drying out, exposure of roots to sun and from other injury.

1.07 PROJECT CONDITIONS

- A. Do not do soil preparation, conditioning or lawn sodding during late Fall, Winter, or hot Summer periods unfavorable to soil conditioning and sodding, and/or in soil conditions conducive to compaction of the soil.
- B. Work Notification: Notify the Architect at least 7 working days prior to start of sodding operations.
- C. Do not do soil preparation, conditioning, and sodding until construction work is completed in the area to be planted.
- D. Protect utilities, paving, and other structures from damage caused by lawn planting operations.
- E. The irrigation system shall be installed and tested prior to lawn planting.

1.08 WARRANTY

- A. Warrant sod to take root and grow, be in a healthy, vigorous condition, providing a uniform, weed free stand of grass with no bare spots, until final acceptance by the Owner.
- B. Replace, in accordance with the drawings and specifications, all sod that is, as determined by the Owner, in nonconformance with the above warranty.

PART 2 PRODUCTS

2.01 SOD

- A. Quantities: Furnish sod in quantities required to complete work as indicated on the Drawings.
- B. Furnish sod in the species indicated on the Drawings.
- C. Nomenclatures: Grass names listed on Drawings conform to standardized plant names established by American Joint Committee on Horticulture Nomenclature, except that for names not covered therein, the established custom of the seed industry is followed.
- D. Quality:
 - 1. Class A, healthy, field grown sod, at least 9 months old, free from other grasses, weeds, insect eggs, diseases, stones and debris.
 - 2. Sod shall be cut to a thickness of 5/8 inch to 3/4 inch and delivered on rolls 6 feet long x 18 inches wide. Small irregular or broken pieces of sod will not be accepted by the Architect.
- E. Substitutions will be allowed only when specified material is proved unavailable and only with the approval of the Architect.

2.02 SOIL CONDITIONERS

- A. Organic Compost: 'Super Humus as available from Redi-Gro Corp (916) 381-6063 or American Soils (510) 883-7200
 - 1. Gradation: A minimum of 90% of the material by weight shall pass a 1/2" screen. Material passing the 1/2" screen shall meet the following criteria:

Percent Passing	Sieve Size
85-100	3/8 inch
50-80	#8 (8 mesh)
0-40	#35 (32 mesh)
 - 2. Organic Content: Minimum 50% based on dry weight and determined by ash method. Minimum 250 lbs organic matter per cubic yard of compost.
 - 3. Carbon to Nitrogen Ratio: Maximum 25:1 if material is claimed to be nitrogen stabilized.
 - 4. pH: 5.5-8.0 as determined in saturated paste.
 - 5. Moisture content: 35-60%.
 - 6. Contaminants: The compost shall be free of contaminants such as glass, metal and visible plastic.
 - 7. Maturity: Physical characteristics suggestive of maturity include:

- a. Color: Dark brown to black
- b. Odor: Acceptable = none, soil-like, musty or moldy
Unacceptable = sour, ammonia or putrid.
- c. Particle characterization: identifiable wood pieces are acceptable but the balance of material should be soil-like without recognizable grass or leaves.

B. Any other soil conditioner and /or fertilizer required by the Soils Analysis Report.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing of construction.

3.03 SOIL PREPARATION

- A. Grades:
 - 1. Grades have been established under work of another Section to within 0.1' plus or minus, of required finished grades.
 - 2. Verify that grades are within 0.1' plus or minus, of required finished grades.
 - 3. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All areas to be planted in lawn shall be cleaned of all weeds and debris prior to any soil preparation or grading work. Weeds and debris shall be disposed of off the site.
- C. Do not perform any soil preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and sodding.
- E. Soil Loosening:
 - 1. Scope:
 - a. Lawn areas where no topsoil is indicated or specified: loosen soil as specified below.
 - b. Lawn areas where topsoil is indicated or specified: no loosening is required unless, as determined by the Architect, topsoil has become compacted by construction.
 - 2. Loosening:
 - a. Cultivate soil to depths specified below. Add water as necessary and cultivate in two directions until the entire depth is loose and friable. Remove all debris, base rock, paving and rocks over 2-inches in diameter from the site.
 - b. All areas to be sodded: Cultivate 8-inches deep.

3.04 SOIL CONDITIONING

- A. General: After soil preparation has been completed and high and low spots graded, add soil amendments as indicated below and rototill, making repeated passes with the cultivator to the depth specified until the amendments have been thoroughly mixed.
- B. Sod Areas: Rototill the following into the top 5 inches of soil at the specified rates per 1000 square feet of area:
 - 1. Organic Compost: 6 cubic yards (2" layer).

3.05 FINISHED GRADING

- A. When weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled, all sod areas shall be smooth-graded, ready for sodding.
- B. Grading shall be done when soil is at optimum moisture content for working.
- C. Grades:
 - 1. The Contractor shall make himself familiar with site grading plans and do finished grading in conformance with said plans and as herein specified.
 - 2. Finished grades shown on site-grading plans are given in feet and decimal fractions of feet. Slope uniformly between given spot elevations. Planting areas, including lawns, shall be true to grade with a 10-foot straight edge.
 - 3. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given or between points established by walks, paving, curbs, or catch basins. Finished grades shall be smooth, even, and on a uniform plane with no abrupt change of surface. Minor adjustments of finish grades shall be made at the direction of the Architect, if required.
 - 4. All grades shall provide for natural runoff of water without low spots or pockets. Flow-line grades shall be accurately set and shall not be less than 2-percent gradient wherever possible.
 - 5. Sod Areas: Finished grade of sod bed shall be 3/4 inch below top of adjacent pavement, curbs, or headers.
 - 6. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.

3.06 SODDING

- A. General:
 - 1. Do not install sod until all construction work has been completed and sprinkler systems have been installed and tested. Lawn areas shall have been graded and prepared as herein specified and shall have been approved by the Architect.
 - 2. Do not plant during unfavorable weather.
 - 3. Soil shall be at an optimum moisture content for planting. Do not plant in dry soil or muddy soil.
 - 4. After the areas have been loosened, conditioned, and finish-graded as previously specified, they shall be hand-raked to remove all clods, weeds, roots, debris, and rocks 1-inch in diameter and larger.
 - 5. After the areas have been prepared, no heavy objects (except lawn rollers) shall be taken over the areas at any time.
 - 6. Roll the entire lawn area with approved lawn rollers and re-grade any areas that settle below indicated finished grades.
 - 7. Final grades shall be approved by the Architect prior to fertilizing and sodding.
- B. Fertilizing:
 - 1. Do not fertilize until finished grades are approved by the Architect.
 - 2. Apply fertilizer at the rate according to the soils analysis report. Incorporate into top 2 inches of soil.
 - 3. Apply fertilizers by mechanical rotary or drop type distributor, thoroughly and evenly incorporated with soil. Fertilize areas inaccessible to power equipment with hand tools.

- C. Sodding:
 1. Sod immediately after preparation of bed.
 2. Moisten sod bed thoroughly.
 3. Lay sod with close fitting joints, staggering the ends of the strip in alternating rows. Use sod pieces no smaller than 1 square foot for plugging gaps.
 4. Do not lay sod on top of the root ball/crown of any tree; leave the root ball bare, with sod flush to allow drainage away from the root crown. At existing trees, leave a three-foot diameter bare area with the sod flush as specified above.
 5. Do not leave any sod stockpiled overnight.
- D. Watering: after sod is laid, irrigate thoroughly so that water penetrates soil to a depth of 6 to 8 inches.
- E. Rolling: When grass surface has dried, roll to eliminate irregularities and bring all sod in contact with the sod bed.

3.07 PROTECTION

- A. Protect all sodded areas against trespassing and damage at all times. If any sodded areas are damaged, re-sod as directed by the Architect, without additional cost to the Owner.
- B. Do not execute work in or over sodded lawn areas or adjacent to planting without proper safeguards and protection.

3.08 GENERAL CLEANUP

- A. Remove all surplus materials, and other debris from site. Neatly dress and finish all lawn areas. Flush walks, paved areas, and the like, clean to the satisfaction of the Architect.

3.09 MAINTENANCE

- A. Establishing Maintenance Period:
 1. As soon as all sodded lawn installation is completed, a planting review and preliminary inspection to determine the condition of the lawns will be held by the Architect upon request of the Contractor.
 2. Upon approval of the work by the Architect, the 90-day maintenance period shall begin.
- B. Maintenance of Lawns: Continuously maintain all lawns in areas included in the Contract from the beginning of Contract work, during the progress of work, and for the length of the maintenance period after completion of all work until final acceptance of all Contract work by the Owner.
- C. Scope:
 1. New lawns
 2. Existing lawns within the construction area.
 3. Continuous operations of watering, weeding, mowing, trimming, edging, rolling, fertilizing, spraying, insect, pest, fungus, and rodent control, and any other operations to assure good normal growth.
- D. Fertilizing: In addition to fertilizing of lawns herein specified, furnish and apply any additional fertilizers necessary to maintain plantings in a healthy, green, vigorous growing condition during the maintenance period.
- E. Mowing:
 1. Winter: Mow grass to 1½ inches when it reaches a height of 2-1/2 inches.
 2. Other seasons: Mow grass to 2½ inches when it reaches a height of 3-1/2 inches.
- F. Weeding and Cleanup: Lawn areas shall be kept neat and free from debris at all times and shall be weeded at not more than 10-day intervals.
- G. Insect, Pest, and Disease Control:
 1. Insects and diseases shall be controlled by the use of approved insecticides and fungicides.

2. Moles, gophers, and other rodents shall be controlled by traps, approved pellets inserted by probe gun, or other approved means.
- H. Protection: Work under this Section shall include complete responsibility for maintaining adequate protection for all lawn areas. Any damaged areas shall be repaired at no additional expense to the Owner.
1. Replacements: Immediately re-sod any lawn areas that die out or are damaged.
Replacements shall be made to the Specifications as required for original plantings.
 2. Condition of Lawns at the End of the Maintenance Period:
 3. All lawns shall be live, healthy, undamaged, and free from infestations.
 4. All lawn areas shall be completely and uniformly covered at the time of final acceptance, leaving no barren spots.
 5. Lawns shall be free of all weeds (broadleaf and grass weeds).
 6. Lawns that do not conform to Specifications shall be re-sodded and brought to a satisfactory condition before final acceptance of the work can be made.

END OF SECTION

SECTION 32 9300**PLANTING****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Soil preparation and conditioning
- B. Installation of plant materials
- C. Sheet mulching
- D. Maintenance

1.02 RELATED WORK

- A. Section 31 2000 – Earth Moving
- B. Section 32 8400 – Irrigation System
- C. Section 32 9110 – Topsoil
- D. Section 32 9113 – Import Topsoil
- E. Section 32 9219 – Hydroseeding
- F. Section 32 9223 – Sodding

1.03 REFERENCES

- A. All local, municipal, and state laws, codes and regulations relating to all portions of this work are to be incorporated as part of these Specifications. These specifications shall not be construed to conflict with any of the above codes, regulations, or requirements. The Specifications and Drawings shall take precedence when they call for materials, workmanship or construction of a better quality or higher standard than required by the above-mentioned codes and regulations. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.
- B. State of California Model Water Ordinance
- C. Organic Materials Research Institute (OMRI)
- D. Public utility agency having jurisdiction over the project work.
- E. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
- F. "American Standards for Nursery Stock," American Association of Nurseryman, 230 Southern Building, Washington, D.C. 20005, , ANS1 z60.1.
- G. International Society of Arboriculture, Guide for Plant Appraisal, latest version.
- H. US Composting Council Compost Analysis Program (CAP)
- I. US Composting Council (USCC) Seal of Testing Assurance (STA) program.
- J. Test Methods for the Evaluation of Composting and Compost (TMECC)
- K. ASTM International: D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- L. Manufacturer's recommendations.

1.04 QUALITY ASSURANCE

- A. Comply with sizing and grading standards of the latest edition of "American Standards for Nursery Stock." ANS1 z60.1. A plant shall be dimensioned as it stands in its natural position.
- B. All plant materials shall be nursery grown under climatic conditions similar to those in the locality of the project.
- C. Plant materials shall be inspected and approved at the place of growth, for compliance with specification requirements for quality, size, and variety prior to being delivered to the site.
 - 1. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during progress of the work.
 - 2. Notify the Landscape Architect of the source of material no later than 30 days after award of the contract.
 - 3. One inspection at the place of growth shall be made. All plants materials requiring inspection by the Owner shall be assembled and available for inspection.
 - 4. If the Landscape Architect is required to make additional inspections at the place of growth due to failure of the Contractor to assemble the required plant materials, then photos that indicate the quality, size and variety may be acceptable.
 - 5. Remove unacceptable plant materials immediately from job site.
- D. Furnish all certificates of inspection that are required by county or state authorities.

1.05 SUBMITTALS

- A. Soils analysis report through Waypoint Analytical Laboratory Inc, 1101 S. Winchester Blvd, Suite G-173, San Jose, CA 95128 Tel (408) 727-0330 or equal. The soil laboratory must be Seal of Testing Certified. Analyses are to be obtained at Contractor's cost and are to include:
 - 1. A05-2 Analysis Report to include amendment recommendations based on an "organic" approach to soil and landscape management. A05-2 requires a 4-cup sample.
 - a. Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Existing soil shall be amended per soils analysis report.
 - 2. Test for parasitic nematodes only if the import soil is from an agricultural source.
 - 3. The soil analysis lab test must be conducted within 120 days prior to the start date of planting.
- B. Submit the following material samples:
 - 1. Tree ties, guying materials, soil conditioners, gravel and bark mulch materials.
- C. Submit the following materials certification from approved qualified testing laboratories within 120 days prior to the start date of planting.
 - 1. Soil conditioners and fertilizers
 - 2. Import topsoil
 - 3. List of all plant materials from the nursery, associated sizes and varieties.
- D. Fertilizers or soil amendment materials prohibited by Organic Materials Research Institute (OMRI) in its generic materials list are prohibited in construction of the project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.
- B. Protect plants in transit and after delivery to the Project site. Plants in broken containers and plants with broken branches or injured trunks will be rejected. Remove rejected material from the site immediately.

1.07 PROJECT CONDITIONS

- A. Do not do soil preparation, conditioning, and planting until construction work is completed in the area to be planted.
- B. Protect utilities, paving, and other structures from damage caused by planting operations.
- C. The irrigation system shall be installed and tested prior to planting.

1.08 WARRANTY

- A. Warrant plant material to take root and grow, remain alive and, be in a healthy, vigorous condition for a period of one year after completion and acceptance of entire project.
- B. Replace, in accordance with the drawings and specifications, all plants that are dead or, as determined by the Architect, are in an unhealthy or an unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacements is at the Contractor's expense. Warrant all replacement plants for one year after installation.
- C. Warranty shall not include damage or loss of trees, plants or groundcovers caused by fires, floods, freezing rains, or winds over 75 miles per hour, winter kill caused by extreme cold, and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.
- D. Within 15 days of written notification by the Owner, remove and replace all guaranteed plant materials that, for any reason, fail to meet requirements of guaranty. Replacements shall be made to same specifications required for original materials and shall carry the same guaranty from the time they are replaced.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

- A. Quantities: Plant materials shall be furnished in quantities required to complete work as indicated on the Drawings and shall be of species, kinds, sizes, etc., specified.
- B. Nomenclatures: Plant names listed on Drawings conform to standardized plant names established by American Joint Committee on Horticulture Nomenclature, except that for names not covered therein, the established custom of the nursery trade is followed.
- C. Quality:
 - 1. Plants shall be symmetrical and typical for variety and species.
 - 2. Plants shall be sound, healthy, vigorous, and free from plant disease and insect pests or their eggs.
 - 3. All trees and shrubs shall be container grown or established "boxed-out", field-grown material unless otherwise specified.
 - 4. Container stock shall be grown in containers, in which delivered, for at least 8 months, but shall not be root bound. Container plants with cracked or broken balls of earth when taken from containers may be planted only with specified approval of the Architect.
 - 5. Plants shall not be pruned prior to delivery, except as authorized by the Architect.
- D. Substitutions will be allowed only when specified material is proved unavailable and only with the approval of the Architect.
- E. Furnish plant materials within the height and spread ranges indicated and/or specified on the drawings. Larger stock is acceptable, at no additional cost. At least 75 percent of the stock shall be equal to the larger size in each range.
- F. Provide specimen size plant materials with a special height, shape or character of growth as indicated and/or specified on the drawings. Tag specimen trees and shrubs at the source of

supply. The Architect will inspect specimen selections at the source of supply for suitability and adaptability to the selected location. When specimen plant materials cannot be purchased locally, provide sufficient photographs of the proposed materials for approval.

- G. Groundcover Plants:
 1. Groundcover plants, unless otherwise indicated on the Drawings, shall be rooted plants grown in flats.
 2. Plants shall be full and compact, not "leggy".

2.02 SOIL CONDITIONERS

- A. Organic Compost: 'Super Humus' as available from Redi-Gro Corp (916) 381-6063 or "Z- Best Products (408) 586.9292
 1. Gradation: A minimum of 90% of the material by weight shall pass a 1/2" screen. Material passing the 1/2" screen shall meet the following criteria:

Percent Passing	Sieve Size
85-100	9.51 mm (3/8 inch)
50-80	2.38 mm (No. 8, 8 mesh)
0-40	500 microns (No. 35, 32 mesh)
 2. Organic Content: Minimum 50% based on dry weight and determined by ash method. Minimum 250 lbs organic matter per cubic yard of compost.
 3. Carbon to Nitrogen Ratio: Ranges from 14:1 – 20:1.
 4. pH: 6.0 – 8.2 as determined in saturated paste.
 5. Moisture content: 35-60%
 6. Contaminants: The compost shall be free of contaminants such as glass, metal, and visible plastic.
 7. Maturity: Physical characteristics suggestive of maturity include:
 - a. Color: dark brown to black
 - b. Odor:
 - Acceptable= none, soil-like, musty or moldy
 - Unacceptable= sour, ammonia or putrid
 - c. Particle characterization: identifiable wood pieces are acceptable but the balance of material should be soil-like without recognizable grass or leaves.
 8. The compost analysis must be conducted within 120 days prior to the start day of planting.
- B. Synthetic Controlled Release Fertilizer: Not permitted.
- C. Organic Fertilizer: Compost Tea Bags or Root Zone Feeder Paks, 4-6-4, Sustane Natural Fertilizer of America, Inc. 1 (507) 263.3003, www.sustane.com. Follow manufacturer's instructions for quantity and placement.
- D. Any other soil conditioner and/or fertilizer required by the Soils Analysis Report.

2.03 SOIL FOR PLANT BACKFILL MIX - IMPORT TOPSOIL

- A. Soil type: Agricultural Loam; Maximum 50% clay & silt fines
- B. Agricultural Suitability:

Salinity (ECe x 10(3)):	0-2
Sodium (SAR) 2:	0-8
(ESP) 1:	0-10
Boron (PPM in Saturated Extract):	0-0.7
pH	5.5 - 7.5
- C. Quality: Loose, friable, and at optimum moisture content for mixing. No soil in a cloddy or muddy condition will be allowed.

2.04 ACCESSORIES

- A. Steel Tree Stakes:

1. "R2 Stake" and "Mega Stake", screw in auger-type steel stake with adjustable height "T"-bar, UV-resistant vinyl tubing, 3 cable ties, anti-rotational tab and pin, powder-coated dark green, by J.R. Partners, 209-634-7791.
 2. Sizes:
 - a. R2 Stake, 7 foot, ½" diameter, Schedule 40 for 5 and small 15-gallon trees (less than 7') and conifers.
 - b. R2 Stake, 9 foot, ¾" diameter, Schedule 40, for 15 gallon and 24-inch box trees.
 - c. Mega Stake, 11 foot, diameter of 1.66" and .14" wall thickness, for 36" and 48" box trees.
 3. Ties: Fabric-reinforced corded rubber straps without wires; 3/8" x 3/4" x length required by tree-staking details indicated on the Drawings; Grow-Straight, 707/745-4330.
- B. Tree Guys:
1. Anchors: 1-inch galvanized pipe, 3 feet long.
 2. Wires: 1/8-inch flexible galvanized cable.
 3. Hose collars: Fabric-reinforced rubber hose; color matte green.
 4. Marker Tubing: Polyethylene; translucent white; 2-inch diameter.
 5. Cable clamps: Galvanized.
 6. Turnbuckles: 6-inch open aluminum turnbuckle; eye and fittings 5/16" in diameter; 4-1/4" take-up.
- C. Vine Ties:
1. Green or clear vinyl ribbon; no wire reinforcing.
 2. Anchors for wood - 2-inch diameter, No. 10 galvanized eye screws.
 3. Anchors for concrete or masonry walls - heavy duty plastic "eyes" with epoxy adhesive.
- D. Drain Rock: Hard durable crushed rock; ¾ inch dia.
- E. Geotextile Material: Woven Polypropylene monofilament cloth:
1. Poly-Filter GB material; Carthage Mills Inc., Cincinnati, Ohio.
 2. Mirafi 160N, Non-woven fabric; Mirafi Corporation, El Toro, CA.
- F. Prefabricated Drainage Composite: 3/8" thick preformed high impact polymeric waffle pattern sheet faced with woven polypropylene geotextile material; Miradrain 9000, Mirafi Inc. or Hydroproduct HSF, Grace Construction Products.
- G. Tree Well Irrigation Tubes:
1. Rigid perforated Polyvinyl Chloride (PVC) drainpipe; ASTM 2729; 3-inch diameter x 0.075 inches.
 2. Grate Cap: high strength UV stabilized polypropylene round grate; black; NDS-14 or ADP A-3103.
- H. Mulch: Bark Mulch, derived from recycled green waste and screened to 1" – 3" in size, Zankercycling.com, 408.846.1577, or equal.
- I. Weed Barrier Cloth: Pro 5 Weed Barrier, 5 oz woven, needle-punched polypropylene fabric, www.dewittcompany.com
- J. Metal header: Aluminum edging 3/16"x 4" as manufactured by Permaloc Corp. 800-356-9660 or equal. Color to be black.
- K. Cardboard Mulch: Cardboard mulch: 2 layers of 100% recycled B flute cardboard as a biodegradable weed barrier to cover entire planting area. www.stopwaste.org/sheetmulch.
- L. Root Barrier: 24" deep, molded, UV inhibited polyethylene with self-locking joiners.
1. Tensile stress yield 3800 psi, ASTM D638.
 2. UB Series Deep Root Universal Barrier; Deep Root Corporation, 415.781.9700.
 3. NDS – EP Series, 800.726.1994, www.NDSPRO.com

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.
- C. Contaminated Soil:
 - 1. Do not perform any soil preparation work in areas where soil is contaminated with cement, plaster, paint, lime or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
 - 2. Contaminated soil shall be removed to full depth of contaminants with a minimum depth of 12 inches and replaced with acceptable topsoil.

3.03 SOIL PREPARATION

- A. Grades:
 - 1. Grades have been established under work of another Section to within 1 inch, plus or minus, of required finished grades.
 - 2. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All ground areas to be planted shall be cleaned of all weeds and debris prior to any soil preparation or grading work. Weeds and debris shall be disposed of off the site.
- C. Do not perform any soil preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- E. Soil Loosening:
 - 1. Scope:
 - a. Planting areas where no topsoil is indicated or specified: loosen soil as specified below.
 - b. Planting areas where topsoil is indicated or specified: loosening of subgrade is specified in the section on topsoiling, no additional loosening is required unless, as determined by the Architect, topsoil has become compacted by construction.
 - 2. Loosening: Cultivate soil to depths specified below:
 - a. Slopes steeper than 2:1: No loosening required.
 - b. All other areas to be planted: 8 inches deep.
 - c. Add water as necessary and cultivate in two directions until the entire depth is loose and friable.
 - d. Remove all debris, base rock, paving and rocks over 2-inches in diameter from the site.

3.04 SOIL CONDITIONING

- A. General: After soil preparation has been completed and high and low spots graded, add soil amendments as indicated below and rototill, making repeated passes with the cultivator to the depth specified until the amendments have been thoroughly mixed.
- B. Groundcover Areas
 - 1. Flat Grown: Rototill the following into the top 3 inches of soil at the following specified rate per 1000 square feet of area: 6 cubic yards of yard waste compost (2" layer).
 - 2. Container Grown: Excavate and backfill planting holes in accordance with the paragraph on Tree, Shrub, and Vine Planting Holes.
- C. Tree, Shrub, and Vine Planting Holes:
 - 1. Planting Holes:
 - a. Locate planting holes per planting plans bringing any conflict with underground utility lines to the attention of the Architect. Locations for holes shall be staked on the site and the Architect's approval thereof obtained prior to excavating planting holes.
 - b. Excavate square holes to the sizes and depths indicated on the Drawings.
 - c. Scarify the sides and bottoms of the holes.
 - d. Drainage Test for Tree Holes: Fill selected holes in representative soil type areas with water and observe drainage over a 24-hour period. If subsoil appears impervious and planting holes do not drain, bring the condition to the attention of the Architect, and do not proceed with backfilling until written instructions are received from the Architect (refer to Drainage Holes for Tree Planting Holes herein specified).
 - 2. Install 5-gallon and larger plant material so that top of root ball will be even with top of sheet mulch.
 - 3. Backfilling:
 - a. Backfill the planting holes with the special backfill mix herein specified.
 - b. Water-settle backfill thoroughly or compact by other approved method prior to planting so plants do not settle.
 - 4. Special Backfill Mix for Planting Holes:
 - a. Materials for trees, shrubs and vines:
 - 70 percent import topsoil
 - 30 percent yard waste compost
 - b. Mixing: Prepare the mix in stockpiles on site; do not mix at each individual planting hole. Mix thoroughly, leaving no layers of soil amendments or clods of soil.
 - 5. Place fertilizer (quantity and type) as noted in the soils report.
- D. Drainage holes for tree planting holes:
 - 1. Install drainage holes as detailed on the Drawings in all tree-planting holes that have not drained within a 24-hour period.

3.05 FINISHED GRADING

- A. When weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled, all planting areas shall be smooth-graded, ready for placement of plant materials.
- B. Grading shall be done when soil is at optimum moisture content for working.
- C. Grades:
 - 1. The Contractor shall make himself familiar with site grading plans and do finished grading in conformance with said plans and as herein specified.
 - 2. Finished grades shown on site-grading plans are given in feet and decimal fractions of feet. Slope uniformly between given spot elevations. Planting areas, including lawns, shall be true to grade with a 10-foot straight edge.
 - 3. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given or between points established by walks, paving, curbs, or catch basins. Finished grades shall be smooth, even, and on a uniform plane with no abrupt change of

surface. Minor adjustments of finish grades shall be made at the direction of the Architect, if required.

4. All grades shall provide for natural runoff of water without low spots or pockets. Flow-line grades shall be accurately set and shall not be less than 2-percent gradient wherever possible.
5. Shrub and Groundcover Areas: Finished grades shall be 1½ inches below top of adjacent pavement, headers, curbs, or walls, unless otherwise indicated on the Drawings.
6. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.

3.06 PLANTING

- A. General:
 1. Do not install plant materials until all construction work has been completed and sprinkler systems have been installed and tested. Planting areas shall have been graded and prepared as herein specified and shall have been approved by the Architect.
 2. Do not plant during unfavorable weather.
 3. Soil shall be at an optimum moisture content for planting. Do not plant in dry soil or muddy soil.
- B. Weed Control: Apply preemergence herbicide to all groundcover and mulched areas in accordance with the manufacturer's recommended rates. Any plant materials showing loss of vigor or health owing to improper application of the herbicide shall be replaced by the Contractor.
- C. Container Plants:
 1. Do not lift or handle container plants by tops, stems or trunks at any time.
 2. All plants shall be set so that, when settled, the natural grade in the container is 4 inches above the finished grade of lawns and 2 inches above finished grade of other planting beds.
 3. Taper finished grade away from root ball.
 4. In sodded lawn areas set the sod flush with the top of root ball to allow drainage away from the root crown. Leave root crown bare.
 5. Fertilizer: Refer to paragraph 3.04 C.4 above.
 6. All plants shall be planted immediately after the containers are cut, and containers shall be regularly removed from the site so as not to present a hazard to persons using the area.
 7. Watering Basins: Form circular earth basin centered on the stem of each plant. The rim of basin shall be 4- inches above the grade at the stem. Do not form watering basins around trees in lawn areas.
- D. Groundcover Plants:
 1. Install plants at spacings indicated on the Drawings.
 2. Plant in staggered rows, evenly spaced.
 3. Dig holes large enough to allow for spreading of roots. Place plants so root system lies free without doubling.
 4. Firm soil around roots to eliminate air pockets.
 5. Water thoroughly after planting, taking care not to cover crowns of plants with wet soil.

3.07 PROTECTION

- A. Protect all planted areas and plants against trespassing and damage at all times. If any plants are damaged, treat or replace as directed by the Architect, without additional cost to the Owner.
- B. Do not execute work in or over prepared plant areas or adjacent to planting without proper safeguards and protection.

3.08 ACCESSORIES

- A. Cardboard Mulch:
 1. Install two layers of 100% recycled cardboard to the entire planting area, completely covering all existing soil and remaining vegetation that has not been removed.
 2. Wet cardboard while applying.

3. Overlap cardboard a minimum of 12 inches.
 4. Cardboard shall abut directly against edge of pavement, curbs, boulders or other site features. Do not cover tree and shrub root crowns with cardboard.
 5. Fold excess cardboard under itself when at hardscape or root crowns.
 6. Retain any small cardboard scraps to patch holes created during sheet mulch process.
- B. Compost:
1. Apply 2-inch depth of quality OMRI or CDFA listed recycled organic compost on top of the cardboard layer. Taper compost application to ½" when 6" or less from hardscape in all planting areas
- C. Mulching:
1. After installing cardboard and compost, install bark mulch.
 2. Install bark mulch over planting areas indicated on the Drawings.
 3. Mulch shall be 3 inches deep; taper down flush with adjacent paving curbs or headers.
 4. Where watering basins are required around container plants, fill basin with 3- inch deep mulch.
- D. Tree Staking:
1. Scope: Stake all 15 gallon up through 48" box trees.
 2. Installation: Steel Tree Stakes:
 - a. Place the "Reddy Stake" 12 to 14 inches away on the prevailing wind side of the tree. The tree should be one to three inches away from the end of the T-bar. Insert the pin through the hole in the top of the "Reddy Stake" and twist clockwise into the soil.
 - b. Twist the "Reddy Stake" until the tab is 1 to 2 inches below grade. Drive the anti-rotation pin through the hole in the tab and into the soil. Use the handle of a shovel, rake, or two by two, and pack soil firmly around the stake.
 - c. Determine the correct height for the T-bar, keeping in mind it should be no higher than necessary but high enough to hold the tree upright. Slip the T-bar over the top of the "Reddy Stake" to the proper height and tighten the belt.
 - d. Place the UV-resistant, tubing strap around the tree, and slip the ends of the tubing over the ends of the T-bar. Fold both sides of tubing towards the tree trunk and against the T-bar and secure with two of the provided cable ties. Add third cable tie around strap between T-bar and tree trunk.
 - e. Provide custom length T-bar for trees in tree grate.
 3. Nursery stake must be removed. If trunk is too spindly to support itself or has little or no taper then a flexible auxiliary stake of either ¼" spring steel or ½" bamboo should be used to provide needed support. Auxiliary stake should not extend past 2/3 of the tree. Wrap the ends of the auxiliary stake with tape to prevent rubbing and tie with nursery tape (no wire reinforcement) every 10 to 12 inches along the trunk.
 4. Trees shall remain plumb and straight from installation through the contractor warranty period.
- E. Tree Guying:
1. Scope: Guy all boxed specimen trees, 30-inch box, and larger, .
 2. Installation:
 - a. Neatly form hose and cable collars to prevent any bare cable chafing against the tree trunk or branches.
 - b. Weld loop to pipe anchors and galvanize after fabrication.
 - c. Use cable clamps or crimping device for all attachments.
 - d. Do not leave sharp cable ends protruding.
 - e. Install polyethylene marker tubing on all guy wires.
 3. Nursery stake must be removed.
- F. Planting:
1. One-gallon plants
 - a. Push back compost and mulch to expose a circle of cardboard.
 - b. Cut an "X" into cardboard and pull back flaps.

- c. Dig a small hole.
- d. Place plant in hole so that top of root ball is even with top of mulch after planting.
- e. Replace compost and mulch.
- 2. Small plant material (4-inch pots, plugs, etc.)
 - a. Push back compost and mulch to expose a circle of cardboard.
 - b. Place plant on cardboard.
 - c. Replace compost and mulch
 - d. Keep stems and trunks of all plants clear of compost, mulch, and debris.
- G. Training of Vines and Espaliers:
 - 1. Place as many anchors as required to support the plant with branching structure spread in an artistic manner.
 - 2. Tie branches to anchors with vinyl ties.
- H. Headers and Mowing Edges:
 - 1. Install true to line and grade; flush with adjacent paving.
 - 2. Install in alignments indicated on the drawings; make curves and radii smooth and tangent to straight-line segments.
 - 3. Double-stake corners and splices.
- I. Root Barrier:
 - 1. Furnish and install around all trees in tree wells, parking islands, and trees within 5 feet of paving.
 - 2. Install in accordance with the manufacturer's printed instructions.
 - 3. Install flush with finished grade.
 - 4. Install along edge of paving, do not wrap root barrier around root ball.
- J. Tree Irrigation Tubes:
 - 1. Install two tubes per tree well at opposite corners in all trees in paved areas.
 - 2. Fill with drain rock.
 - 3. Set grate cap 2 inch below sidewalk surface.

3.09 INSTALLATION OF WEED BARRIER CLOTH

- A. Overlap weed barrier cloth 6", smooth fabric to get solid contact with the ground underneath. Use 6" long landscape pins to hold the fabric down +/- 24" on center. Place 2" deep of crush gravel on top.

3.10 GENERAL CLEANUP

- A. Remove all cans, surplus materials, and other debris from site. Recycle all containers. Neatly dress and finish all planting areas. Flush walks, paved areas, and the like, clean to the satisfaction of the Architect.
- B. Rinse foliage of all plant materials within the construction area as often as necessary to keep the foliage free from dust generated by construction and planting work.
- C. Post-sheet mulch activities:
 - 1. Conduct a site walk through to identify bare or low areas and exposed cardboard.
 - 2. Add mulch to cover bare or low areas to a depth of 3 inches minimum.
 - 3. Fold exposed cardboard under at curb, trees, valve boxes and other edges.

3.11 INSPECTIONS

- A. Notification: The Contractor shall notify the Landscape Architect a minimum of 72 hours before requiring a visit by the Landscape Architect or his duly appointed representative to the site.
- B. Check Points: The following shall be considered check points and the Contractor shall only proceed with the work after the Landscape Architect has visited the site and determined that the work is proceeding satisfactorily.
 - 1. Completion of placement of soil mix and fine grading.

2. When plant material is placed in the configuration shown on the Drawings before planting.
 3. A check visit shall be made to begin the maintenance period. At this time, the Contractor shall have completed all phases of the Plans and Specifications. Any discrepancies shall be noted at that time and the Contractor shall make appropriate corrections before the acceptance of the work.
 4. A conference including the Owner shall be held at the completion of the work, provided that all deficiencies brought out in the check visit which began the maintenance period have been corrected by this time. The Contractor shall continue to maintain the project at his own expense until all deficiencies have been corrected, at which time the Contractor shall request the Landscape Architect to visit the site and approve the project as complete. The Landscape Architect will accept the landscape project in writing. The date of the acceptance letter shall be the first day of the guarantee period.
- C. Should it be determined at the Final Inspection or Final Acceptance visit that any punchlist item is incomplete, any further review of the site will be terminated until all items are guaranteed, in writing, to be complete by the Contractor. The cost of additional site visits by the Landscape Architect to verify completion of work shall be paid for by the Contractor.

3.12 MAINTENANCE

- A. Contractor shall furnish all labor, material, equipment, and services required to maintain the landscape in a healthy and attractive condition for a period of 90 days.
- B. Maintenance shall include fertilization, watering, insect and disease control (IPM), and weed control using IPM, weekly trash removal, mulching, restaking trees, tightening of guys, resetting plants to proper grades or upright position, and restoration of watering basins. Refer to ReScape specifications, by ReScapeCA.org.
- C. Maintenance period shall not start until all elements of construction, planting, and irrigation for the entire project are complete, approved, and fully functional. Project will not be segmented into maintenance phases, unless specifically authorized in writing by the Owner's authorized representative.
- D. The Contractor shall request an inspection to begin the plant maintenance period after all planting and related work has been completed in accordance with the Contract documents. A prime requirement is that all groundcover and lawn areas be planted. If such criterion is met to the satisfaction of the Architect, a field notification will be issued to the Contractor to establish the effective beginning date of the period.
- E. The Contractor's maintenance period will be extended if the provisions required within the plans and specifications are not fulfilled.
- F. Watering:
 1. All plants shall be kept watered as often as it is necessary to keep them in optimum, vigorous growth. Watering shall be done preferably during the early morning hours. Check soil moisture levels with a soil probe before watering and adjust watering schedule to match weather conditions.
 2. Water shall be controlled so that there will be no excessive run-off, ponding, or overwatering. Check and adjust irrigation system on a weekly basis.
 3. Root Growth: Periodically the Contractor shall check the progress of the root growth within the back fill area. As the root growth increases beyond the root ball, the frequency of watering shall be reduced so that the roots are encouraged to grow to a lower soil depth. Watering then shall be less frequent, but applications shall be very slow and the Contractor shall assure himself that water does penetrate to the depth of the former plant pit.
 4. Replace broken equipment immediately with equal or superior materials.
- G. Spraying:
 1. Utilize IPM practices for plant care, as outlined in the Bay Friendly Landscape maintenance specifications. Spraying shall only be performed as a last resort.

2. All shrubs and trees shall be inspected at least twice a month during the growing period to determine the need for spraying to control insect damage, fungus development or any other disease that might be attacking the plants. Preventative spraying shall be done only with the approval of the Landscape Architect.
 3. Operators of spray equipment shall take all reasonable precautions to protect themselves, other people and buildings from spray. The Contractor shall have all permits and licenses required for such an operation. Where applicable, dormant spray shall be applied to shrubs and trees during the winter period.
 4. All equipment shall be properly washed before and after use.
 5. No spraying shall take place during windy or gusty days.
- H. Staking and Guying: Stakes and guys shall be inspected a minimum of two times a month to assure that the wires and ties are tight and no damage has occurred to the tree trunk or branches.
- I. Weed Control:
1. Weeds shall be kept under control, preferably either by hand or by IPM methods outlined in the Bay Friendly Landscape maintenance specifications. The application of herbicides shall be as last resort.
 2. All equipment used for herbicides, if utilized, shall be properly cleaned before it is used on this project. Herbicides shall be applied at temperatures recommended by the manufacturers. Herbicides shall not be used during windy or gusty days. All possible precautions shall be taken to protect vegetation which is susceptible to damage from the particular herbicides to be used.
 3. The bases of all plants shall be kept completely free of weeds. Periodically, the base of the trees and shrubs shall be cultivated in order to allow better penetration of water, but such cultivation shall be carefully done in order not to destroy surface roots.
- J. Fertilization: Contractor shall provide eight additional soils tests prior to the end of the 90 day maintenance period for final fertilization requirements. Contractor shall fertilize all areas as recommended by soils test. Top dress all areas at 45 day intervals from time of planting with organic fertilizer or compost tea as recommended by soils report. 251bs fertilizer per 1000 s.f.
- K. Litter: The Contractor shall remove promptly after pruning, trimming, and weeding or other work required under the contract, all debris generated by his performance of the work. Immediately after working in the areas of public walks, driveways or paved areas, they shall be vacuumed clean with suitable equipment. All areas covered by this contract shall be kept free of the following items: bottles, cans, paper cardboard or metallic items. Common debris and litter shall be disposed of in an appropriate manner.
- L. Pruning: Prune as necessary to remove injured twigs and branches, dead wood, and suckers.
- M. All green waste shall be taken to a certified green waste facility for utilization in organic compost or mulch.
- N. Soil shall not be worked when wet, generally between October and April for on-going maintenance.
- O. Re-apply organic mulch to a minimum depth of 3 inches for on-going maintenance.
- P. The use of pesticides that are prohibited by Organic Materials Research Institute in its generic material list is not allowed for on-going maintenance.
- Q. Mowing:
1. All mowing shall be done in a neat and orderly manner. Equipment shall be moved onto and off the area to be mowed in such a manner that it will not leave tracks or marks that detract from the finish turf. Timber shall be provided to move equipment over curbs, stairs, or similar constructions.
 2. Mowing equipment shall be kept in optimum operating condition. The equipment shall be washed before initial use on the project so that there will be no chance of introducing foreign seeds or diseases onto the project.

3. Frequency of mowing shall be determined by the rate of growth of the grass. During seasons of peak growth mowing may have to be done every five days to six days; under normal conditions once a week should be adequate.
 4. The average mowing height shall be 1-1/2". The grass blades must be cut sharply and cleanly. The turf must be cut evenly so that no ridges remain in the finish cut. The direction of mowing shall be alternated each time.
 5. Grades: During the maintenance period, all flow lines shall be maintained to allow for free flow of surface water without causing erosion. Displaced materials which interfere with drainage shall be removed and/or relocated as directed. Low spots and pockets shall be regraded to drain properly and plant material replaced. Jute netting shall be installed at flow lines and other locations where erosion is evident as directed by the Owner. Work under this Section shall include complete responsibility for maintaining adequate protection for all areas. Any damaged areas shall be repaired at no additional cost to the Owner.
- R. Replacements: Immediately replace any plant materials that die or are damaged. Replacements shall be made to the Specifications as required for original plantings.
- S. Condition of Plantings at the End of the Maintenance Period:
1. All plant materials shall be live, healthy, undamaged, and free from infestations.
 2. Groundcover, shrub areas, and other planting areas shall be free of all weeds (broadleaf and grass weeds).
 3. Plantings that do not conform to Specifications shall be replaced and brought to a satisfactory condition before final acceptance of the work can be made.

3.13 GUARANTEE AND REPLACEMENT

- A. Guarantee period shall be extended for a period of one year from the date of written acceptance and once a warranty walk has been completed with the Owner. The Contractor shall schedule a one year walk with the Owner for review of all plant material. Failure to schedule a one year maintenance walk will not relieve the Contractor of the guarantee.
- B. All plants shall be guaranteed to be alive and healthy as determined by the Landscape Architect at the end of the guarantee period.
- C. Plant materials supplied by Owner shall be under similar warranty against defective workmanship during the planting operations. Plant material exhibiting conditions which are determined by the Landscape Architect as being unacceptable, due to workmanship by the Contractor, shall be replaced at no additional cost to the Owner.
- D. The Contractor shall replace, in accordance with the Drawings and Specifications throughout the guarantee period, any plants that die, or in opinion of the Landscape Architect, are in an unhealthy or unsightly condition, and or have lost their natural shape due to dead branches, excessive pruning, inadequate or improper maintenance, or any other causes due to the Contractor's negligence. The Contractor shall not be held responsible for acts of vandalism occurring after the beginning of the guarantee period.

END OF SECTION

GUARANTEE FOR PLANT MATERIAL

WE HEREBY GUARANTEE THAT THE PLANT MATERIAL WE HAVE FURNISHED AND INSTALLED ARE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP, AND THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. WE AGREE TO REPLACE ANY PLANTING WHICH IS IN ANY STATE OF DECLINE, DISEASED, OR HAVE DIED WITHIN THE 12 MONTH WARRANTY PERIOD. WE AGREE TO REPAIR OR REPLACE ANY DEFECTS IN MATERIAL OR WORKMANSHIP, ANY SETTLING OF PLANT MATERIAL, WHICH MAY DEVELOP DURING THE PERIOD OF ONE YEAR FROM DATE OF ACCEPTANCE AND ALSO TO REPAIR OR REPLACE ANY DAMAGE CAUSED RESULTING FROM THE REPAIRING OR REPLACING OF SUCH DEFECTS AT NO ADDITIONAL COST TO THE OWNER. ORDINARY WEAR AND TEAR, UNUSUAL ABUSE OR NEGLIGENCE ARE EXCEPTED. WE SHALL MAKE SUCH REPAIRS OR REPLACEMENTS, INCLUDING COMPLETE RESTORATION OF ALL DAMAGED IRRIGATION, PLANTING, PAVING, OR OTHER IMPROVEMENTS OF ANY KIND, WITHIN A REASONABLE TIME, AS DETERMINED BY THE OWNER, AFTER RECEIPT OF WRITTEN NOTICE. IN THE EVENT OF OUR FAILURE TO MAKE SUCH REPAIRS OR REPLACEMENTS WITHIN A REASONABLE TIME AFTER RECEIPT OF WRITTEN NOTICE FROM THE OWNER, WE AUTHORIZE THE OWNER TO PROCEED TO HAVE SAID REPAIRS OR REPLACEMENTS MADE AT OUR EXPENSE AND WE WILL PAY THE COSTS AND CHARGES THEREFORE UPON DEMAND.

PROJECT: _____

LOCATION: _____

CONTRACTOR: _____

LICENSE NO: _____

ADDRESS: _____

TELEPHONE: _____

GUARANTEE TO: _____

DATE OF ACCEPTANCE: _____

AUTHORIZED REPRESENTATIVE: _____

SECTION 33 1116
FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.02 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backflow preventers and assemblies.
 - 2. Fire hydrants.
- B. Field quality-control test reports.
- C. Operation and maintenance data for the following:
 - 1. Backflow preventers.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- E. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.04 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.05 COORDINATION

- A. Coordinate connection to water main with EBMUD.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 1. Comply with UL 1285 for fire-service mains if indicated.
 2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.02 JOINING MATERIALS

- A. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.03 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.

2.04 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. Manufacturers:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - c. Mueller Co.; Water Products Div.
- B. UL/FMG, Cast-Iron Gate Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. NIBCO INC.
 - i. U.S. Pipe and Foundry Company.
 - 2. UL/FMG, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 3. Standards: UL 262 and FMG approved.

2.05 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.

- h. U.S. Pipe and Foundry Company.
- 2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.06 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amcast Industrial Corporation; Lee Brass Co.
 - b. Jones, James Company.
 - c. Mueller Co.; Water Products Div.
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.07 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products Div.
 - 2. Standard: AWWA C511
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: Per Plan.
 - 5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 - 6. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

- B. Double-Check, Backflow-Prevention Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products Div.
 - 2. Standard: AWWA C510.
 - 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 - 4. Size: Per Plan.
 - 5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 - 6. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.08 FIRE HYDRANTS

- A. Fire Hydrants:
 - 1. Available Models: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - a. Clow 850 or 950
 - b. Long Beach 610 or 425
 - c. Mueller A-481-F

2. Description: Fire hydrant outlets shall include one 4-1/2 inch pumper nozzle and one or two 2-1/2 inch hose nozzles (depending on location), all with "National Standard" threads.
 - a. Hydrant risers shall be Clow/Rich No. 100 with localized break-off scoring on the exterior near each flanged end. Top hydrant riser shall be installed with breakaway-style bolts at connection to hydrant.
 - b. Exterior finish: White.

2.09 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connections:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire End & Croker Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. Kidde Fire Fighting.
 - e. Potter Roemer.
 - f. Reliable Automatic Sprinkler Co., Inc.
 2. Description: Exposed, freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch-high brass sleeve; and round escutcheon plate.
 - a. Standard: UL 405.
 - b. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet.
 - c. Inlet Alignment: Inline, horizontal.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Flanges, unions, and special fittings may be used, instead of joints indicated.
- D. Underground water-service piping NPS 3/4 to NPS 3 shall be soft copper tube, ASTM B 88, Type K wrought-copper, solder-joint fittings; and brazed joints.
- E. Underground water-service piping NPS 4 and NPS 6 shall be any of the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
 2. PVC, AWWA Class 200 pipe; ductile iron fittings; and gasketed joints.
 - a. Aboveground and Vault Water-Service Piping NPS 4 and NPS 6 shall be the following
 3. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
- F. Underground Fire-Service-Main Piping NPS 4 to NPS 8 shall be any of the following:
1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
 2. PVC, AWWA Class 200 pipe listed for fire-protection service; ductile iron; and gasketed joints.
- G. Aboveground Fire-Service-Main Piping NPS 4 to NPS 8 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- H. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 10 shall be any of the following:
1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
 2. PVC, AWWA Class 200 pipe listed for fire-protection service; ductile iron fittings; and gasketed joints.

3.03 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for underground installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves: AWWA, cast-iron, nonrising-stem, seated gate valves with valve box.
 2. Aboveground Valves: AWWA, cast iron, OS&Y rising stem, resilient seated.

3.04 PIPING INSTALLATION

- A. Comply with NFPA 24 for fire-service-main piping materials and installation.
- B. Make connections larger than NPS 2 with tapping machine according to the following:
1. Install tapping sleeve and tapping valve according to MSS SP-60.
 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 and smaller with drilling machine according to the following:
1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.

2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 4. Install corporation valves into service-saddle assemblies.
 5. Install manifold for multiple taps in water main.
 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- G. Bury piping with depth of cover over top at least 36 inches.
- H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping within five (5) feet of building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.05 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.06 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 2. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.07 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.08 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. AWWA Fire Hydrants: Comply with AWWA M17.
- C. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.09 CONNECTIONS

- A. Arrange water-distribution piping to existing water main with utility company having jurisdiction.
- B. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 33 3100
SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Precast concrete manholes.

1.02 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.03 SUBMITTALS

- A. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- B. Field quality-control test reports.
- C. Product Data: For the following:
 - 1. Cleanouts.
 - 2. Pipe material.

1.04 PROJECT CONDITIONS

- A. Site Information: Research public utility records and verify existing utility locations prior to ordering any materials. Notify the Architect immediately if any discrepancies are found in the project survey.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.03 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings: According to the following:
 1. PVC Sewer Pipe and Fittings, NPS 4 to NPS 15: ASTM D 3034, SDR 26, for gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seals.

2.04 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 2. For Dissimilar Pipes: ASTM D 5926, PVC, or other material compatible with pipe materials being joined.

2.05 CLEANOUTS

- A. Gray-Iron Cleanouts: ASTM A-48, Class 25, round, gray-iron housing with clamping device and round, secured, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:
 1. Light Duty: In earth or grass foot-traffic areas.
 2. Medium Duty: In paved foot-traffic areas.
 3. Heavy Duty: In vehicle-traffic service areas.
 4. Extra-Heavy Duty: In roads.
 5. Sewer Pipe Fitting and Riser to Cleanout: AWWA C151, ductile iron pipe and fittings with push-on joints.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.06 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation if site conditions warrant and/or as shown in the plans.
 - 3. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Riser Sections: 5-inch minimum thickness, and of length to provide depth indicated.
 - 5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 6. Gaskets: ASTM C 443, rubber.
 - 7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
 - 8. Steps: Individual fiber reinforced plastic (FRP) steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12-inch intervals.
 - 9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 - 10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
 - 11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording "SANITARY SEWER."
 - a. Material: ASTM A 536, Grade 65-45-12 ductile iron, designed for heavy duty service, unless otherwise indicated.

2.07 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fly Ash: ASTM C 618, Class C.
 - 3. Fine Aggregate: ASTM C 33, sand.
 - 4. Course Aggregate: ASTM C 33, uniformly graded, from a single source, with course aggregate Class 4N.
 - 5. Water: Potable; ASTM C 94.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/ cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 3000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.

2.08 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, green, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description equivalent to "SANITARY SEWER".

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Section 312000.
- B. Identification: Arrange for installing green warning tapes directly over piping and at outside edges of underground structures. Use detectable warning tape over all piping and over edges of underground structures.
- C. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- D. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- E. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- F. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- G. Install gravity-flow, nonpressure, drainage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping, as indicated, with gasketed caps or plugs securely fastened to withstand test pressures and according to the following:
 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
 2. Install piping with 36-inch minimum cover.
 3. Install piping below frost line.

- H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
- I. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.02 PIPE JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 33 Section "Common Work Results for Plumbing." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
 - 2. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

3.03 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements.

3.04 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use light-duty cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use medium-duty cleanouts in paved foot-traffic areas.
 - 3. Use heavy-duty top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.05 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains.
- B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
- C. Make connections to existing piping and underground structures so finished Work complies with requirements specified for new Work.

3.06 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 3. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Test plastic gravity sewer piping according to ASTM F 1417.
- C. Manholes: Perform hydrostatic test according to ASTM C497.

- D. Leaks and loss in test pressure constitute defects that must be repaired.
- E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 33 4100
STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Precast concrete manholes.
 - 3. Catch basins.

1.02 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.03 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details for the following:
 - 1. Precast concrete manholes, including frames and covers.
- B. Field quality-control test reports. Product Data: For each type of product indicated.
- C. Product Data: For each type of product indicated.
 - 1. Cleanouts.
 - 2. Inlets.
 - 3. Drains.
 - 4. Pipe
 - 5. Fittings.

1.04 PROJECT CONDITIONS

- A. Site Information: Research public utility records, and verify existing utility locations prior to ordering any materials. Notify Architect immediately if any discrepancies are found in the project survey.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.03 PE PIPE AND FITTINGS

- A. PE Drainage Tubing and Fittings NPS 4 and Larger: ASTM F714, ASTM D3350, PE3608 SDR11, color black with green stripe, with HDPE molded fittings.

2.04 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.05 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.06 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:
 1. Light Duty: In earth or grass foot-traffic areas.
 2. Medium Duty: In paved foot-traffic areas.
 3. Heavy Duty: In vehicle-traffic service areas.
 4. Extra-Heavy Duty: In roads.
 5. Sewer Pipe Fitting and Riser to Cleanout: AWWA C151, cement lined, for push-on joints, ductile-iron pipe and fittings (PVC of same material as sewer piping).

- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.07 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation, if site conditions warrant and/or as shown in the plans.
 - 3. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Riser Sections: 5-inch minimum thickness, and of length to provide depth indicated.
 - 5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 6. Gaskets: ASTM C 443, rubber.
 - 7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
 - 8. Steps: Individual fiber reinforced plastic (FRP) steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12-inch intervals.
 - 9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 - 10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
 - 11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - a. Material: ASTM A 536, Grade 65-45-12 ductile iron, designed for heavy duty service, unless otherwise indicated.

2.08 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fly Ash: ASTM C 618, Class C.
 - 3. Fine Aggregate: ASTM C 33, sand.
 - 4. Course Aggregate: ASTM C 33, uniformly graded, from a single source, with course aggregate Class 4N.
 - 5. Water: Potable; ASTM C 94.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/ cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 3000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.

2.09 CATCH BASINS

- A. Catch Basins and Grates: As shown on the Drawings.

2.10 STORMWATER INLETS

- A. Curb Inlets: As shown on the Drawings.

2.11 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, green, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description equivalent to "STORM SEWER".

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Section 312000.
- B. Identification: Arrange for installing warning tapes directly over piping and at outside edges of underground structures. Use detectable warning tape over all piping and over edges of underground structures.
- C. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- D. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

- E. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- F. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- G. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install piping with 36-inch minimum cover, unless noted otherwise.
 - 3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 4. Install piping below frost line.
- H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.02 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
 - 2. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
 - 3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.03 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements.

3.04 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use light-duty cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use medium-duty cleanouts in paved foot-traffic areas.
 - 3. Use heavy-duty top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use extra-heavy-duty, top-loading classification cleanouts in roads.

- B. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.05 CATCH BASIN INSTALLATION

- A. Set invert, rim, and/or grates to elevations indicated on Drawings.

3.06 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's storm building drains.
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
- C. Make connections to existing piping and underground structures so finished Work complies with requirements specified for new Work.

3.07 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 3. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

- a. Test plastic gravity sewer piping according to ASTM F 1417.
- C. Manholes: Perform hydrostatic test according to ASTM C497.
- D. Leaks and loss in test pressure constitute defects that must be repaired.
- E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.08 PROTECTION AND CLEANING

- A. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- B. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - 1. Place plug in end of incomplete piping at end of day and when work stops.
 - 2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction. Minimum flushing velocity shall be 2.5 fps.

END OF SECTION

**SECTION 33 4300
BIO TREATMENT SOIL MIX**

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 1. Scarification of Subgrade
 2. Installation of import bioswale soil.

1.02 RELATED WORK

- A. Section 31 2000 – Earth Moving
- B. Section 32 1313 – Site Concrete
- C. Section 32 9300 – Planting

1.03 REFERENCES

- A. Seal of Testing Assurance (STA)

1.04 QUALITY ASSURANCE

- A. Provide written laboratory tests on any required import topsoil, prepared by a reputable firm experienced in the field of soils and plant nutrition.
- B. The laboratories must be STA Certified.
- C. All tests will be paid for by the Owner, but the cost of re-testing of topsoil required because of rejected topsoil submittals will be deducted from the amount due the Contractor under this Section.
- D. Soils for biotreatment or bioretention areas shall meet two objectives:
 1. Be sufficiently permeable to infiltrate runoff at a minimum rate of 5” per hour during the life of the facility
 2. Have sufficient moisture retention to support healthy vegetation

1.05 SUBMITTALS

- A. Source of supply of proposed import bioswale soil.
- B. Submittal Requirements – The applicant shall submit to the Architect for approval:
 1. A minimum one-gallon size sample of mixed bio treatment soil mix.
 2. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
 3. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils or Caltrans Test Method (CTM) C202.
 4. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in 1.04.
 5. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, “Loss-On-Ignition Organic Matter Method”.
 6. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
 7. A description of the equipment and methods used to mix the sand and compost to produce Bio Treatment Soil Mix.
 8. Provide the name of the testing laboratory(s) and the following information:

- a. Contact person(s)
 - b. Address(s)
 - c. Phone contact(s)
 - d. E-mail address(s)
 - e. Qualifications of laboratory(s), and personnel including date of current certification by USCC, ASTM, Caltrans or approved equal
- C. Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site. Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

1.06 PROJECT CONDITIONS

- A. Do not do subgrade preparation, or topsoil installation until construction work is completed in the area to be planted and the subgrade for topsoil is approved by the Architect.
- B. Protect utilities, paving, and other structures from damage caused by topsoil operations.
- C. Do not purchase or deliver any required import topsoil to the site without the written approval or the proposed topsoil by the Architect.

PART 2 PRODUCTS

2.01 IMPORT BIOSWALE SOIL

- A. Furnish and install sufficient topsoil to complete the work as indicated on the Drawings and herein specified.
- B. Bioretention soils shall meet the following criteria.
 - 1. General Requirements – Bioretention soil shall:
 - 2. Achieve a long-term, in-place infiltration rate of at least 5 inches per hour.
 - 3. Support vigorous plant growth.
 - 4. Consist of the following mixture of fine sand and compost, measured on a volume basis:
 - 60%-70% Sand
 - 30%-40% Compost
 - 5. Sand for Bioretention Soil
 - a. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve shall be nonplastic.
 - b. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40 or #50, #30, #16, 38, #4, and 3/8-inch sieves (ASTM D 422, CTM 202 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	<i>Min</i>	<i>Max</i>
3/8 inch	100	100
#4	90	100
#8	70	100
#16	40	95
#30	15	70
#40 or #50	5	55
#100	0	15
#200	0	5
 - c. Note: All sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.
 - 6. Composted Material – Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

7. Compost Quality Analysis by Laboratory – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council’s Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Examination of Composting and Compost (TMECC). The lab report shall verify:
 - a. Organic Matter Content: 35% - 75% by dry wt.
 - b. Carbon and Nitrogen Ratio: C:N < 25:1 and C:N > 15:1
 - c. Maturity/Stability – Any one of the following is required to indicate stability:
 - 1) Oxygen Test < 1.3 O₂ /unit TS /hr
 - 2) Specific oxy. Test < 1.5)² /unit BVS /hr
 - 3) Respiration test < 8 mg CO₂ /g OM/day
 - 4) Dewar test < 20 Temp./ rise (°C) e.
 - 5) Solvita® > 5 Index value
 - d. Toxicity – Any one of the following measures is sufficient to indicate non-toxicity:
 - 1) NH₄⁻ : NO₃-N < 3
 - 2) Ammonium < 500 ppm, dry basis
 - e. Seed Germination > 80% of control
 - f. Plant Trials > 5 Index value
 - g. Solvita® > 5 Index value
 - h. Nutrient Content – Provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
 - i. Total Nitrogen content 0.9% or above preferred.
 - j. Boron: Total shall be < 80 ppm.
 - k. Salinity: Must be reported; < 6.0 mmhos/cm
 - l. pH shall be between 6.2 – 8.2. May vary with plant species.
8. Compost Quality Analysis by Compost Supplier – Before delivery of the compost to the soil supplier the Compost Supplier shall verify the following:
 - a. Feedstock materials shall be specified and include one or more of the following: Landscaping/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
 - b. Maturity/Stability: Shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell or containing recognizable grass or leaves, or is hot (120 deg) upon delivery or rewetting is not acceptable.
 - c. Weed seed/pathogen destruction: Provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.
9. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, ¼ inch, ½ inch, and 1-inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)
	<i>Min</i> <i>Max</i>
1 inch	99 100
1/2 inch	90 100
1/4 inch	40 90
#200	1 10
10. Bulk density shall be between 500 and 1100 dry lbs/cubic yard.
11. Moisture content shall be between 30% - 55% of dry solids.
12. Inerts – Compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1% by weight or volume.
13. Select Pathogens – Salmonella < 3 MPN/4grams of TS, or Coliform Bacteria < 10000 MPN/gram.
14. Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.
15. Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250

Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

C. Verification of alternative bioretention soil mixes

1. Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: "Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation."
2. The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:
 - a. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.
 - b. Submittals – The applicant must submit to the municipality for approval:
 - 1) A minimum one-gallon sample of mixed bioretention soil.
 - 2) Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
 - 3) Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.b.(2)(ii).
 - 4) Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
 - 5) Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
 - 6) A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
 - 7) The name of the testing laboratory(s) and the following information:
 - a) Contact person(s)
 - b) Address(s)
 - c) Phone contact(s)
 - d) E-mail address(s)
 - e) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal
 - c. Bioretention Soil
 - 1) Bioretention Soil Texture – Bioretention Soils shall be analyzed by an accredited lab using #200, and 1/2" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
1/2 inch	97	100
#200	2	5
 - 2) Bioretention Soil Permeability Testing – Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:
 - a) Moisture – Density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).
 - b) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

D. Mulch for Bioretention Basins

1. Three (3) inches of compost mulch (also called aged mulch) is to be applied after planting for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Compost mulch is to be obtained through soil suppliers or directly from commercial recycling yards.
2. Compost mulch shall be a well decomposed, weed free organic matter source.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.03 SUBGRADE PREPARATION

- A. Grades:
 1. Subgrades have been established under work of another Section to within 1 inch, plus or minus, of required grades. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.
 2. Verify that subgrades are within 1" plus or minus, of required subgrades.
 3. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory, or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All ground areas to receive topsoil shall be cleaned of all weeds and debris prior to any subgrade preparation or topsoiling. Weeds and debris shall be disposed of off the site.
- C. Do not perform any subgrade preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- E. Soil Loosening: Soil subgrade in all areas to receive topsoil shall be ripped or cultivated to the depths specified below. Water shall be added, and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed from the site.
 1. All areas to be topsoiled: 10 inches deep.

3.04 INSTALLATION OF BIOSWALE SOIL

- A. Do not install bioswale soil until preparation of subgrade has been approved by the Architect.
- B. Moisture Content: Do not work topsoil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.

- C. Remove noxious weeds, rocks over 2 inches in diameter, and debris from topsoil, and dispose of off the site.
- D. Thickness of bioswale soil shall conform to those indicated on the site grading plans and specified herein.
- E. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regraded until the grade of all planting areas conforms to finished grade indicated on the Site Grading Plans to within plus or minus 1".

3.05 INSTALLATION OF COMPOST MULCH

- A. Compost mulch shall be uniformly applied over the entire area at an average depth of 3 inches as soon as possible after weed removal and planting.
- B. Avoid placing mulch against trunk or stem of any planting material.
- C. Water thoroughly before and after mulching to saturate the root zone and entire mulch layer
- D. All stones, roots or other debris shall be removed from the surface of the mulched areas.

END OF SECTION